PAT America, Inc.

Rheinmetall Elektronik

DS350 G BOOM CONTROL

for
GROVE CRANE
RT865 BXL, TMS 870, TTS 870
WITH 5 SECTION BOOM

TROUBLESHOOTING MANUAL

031-300-190-039 Rev. B 04/30/99

Notice

The information in this document is subject to change without notice.

PAT makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

PAT shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this manual.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without prior consent of PAT.

TABLE OF CONTENTS

Section	Content	Page
1	General Information	1
2	Reference Material	1
3	Warnings	1
4	Service and Maintenance	2
5	Boom Control Interface	3
6	Boom Sequence	9
7	Boom Control Flow	10
8	Ramping	12
9.1	DS 350 G - Boom Components and Setup	13
9.2	Length Transducer Adjustment	15
9.3	DS 350 G - Superstructure Components - TMS/ TTS 870	16
9.4	DS 350 G - Superstructure Components - RT 865 BXL	17
10.1	DS350 G LMI Central unit (751) - TMS/ TTS 870 & RT 865 BXL	18
10.2	LMI Terminal board - TMS/ TTS 870 & RT 865 BXL	19
11.1	Wiring Schematic - TMS/ TTS 870	20
11.2	Wiring Schematic - RT 865 BXL	25
12	Boom Length Percentage Error	29
13	Main Boom Length Error	37
14	Inner Mid Length Error	43
15	Center Mid Length Error	49
16	No Extend or Retract Function in Automode	55
17	Out of Sequence Warning	57
18.1	Additional Error Codes - Operational	62
18.2	Additional Error Codes -System	63

1. General Information

The DS 350 load moment indicator (LMI) with boom control extension is designed to aid the crane operator through the crane operations. The DS 350 with boom control extension is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedure.

2. Reference Material

Parts & Installation Manual:

Crane Model	*PAT- Part number*	*Grove- Part number*
TMS/ TTS 870	031-300-150-662	9-333-103129
RT 865 BXL	031-300-150-659	9-333-103-206

Operator's Handbook:

PAT - Part number
50\350\19_1319e.doc

3. Warnings

The DS 350 load moment indicator (LMI) with boom control extension is an operational aid that warns the crane operator when he approaches an overload condition, a two block condition and an out of boom sequence condition. The boom control extension controls the sequence of the boom during operation. It still remains the operator's responsibility to verify the operation and to select the correct mode during crane operations.

The manual mode is a rigging mode. Lifting loads with manual mode programmed is prohibited.

Should an out of sequence condition occur, the crane operator is responsible to select manual mode to return the sections into sequence before continuing the lift.

The responsibility for safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information provided by the crane and load moment indicator manufacturer.

Proper functioning depends upon proper daily inspection and observance of the operating instructions provided with the crane and load moment indicator.

4. Service and Maintenance

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
   If electrical wiring is damaged, it shall be replaced immediately.

2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

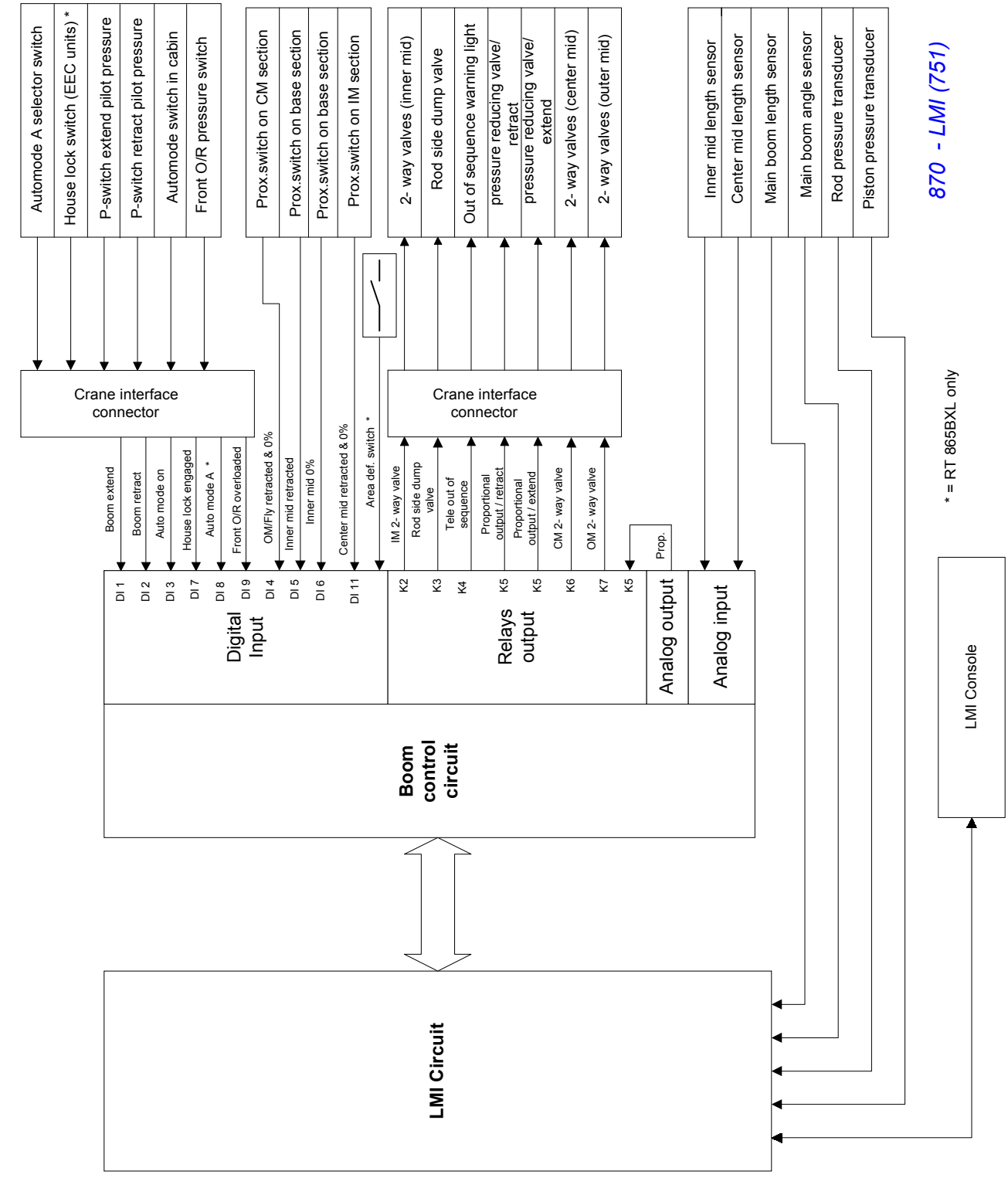
3. Check the anti two-block limit switches for freedom of movement.

4. The cable reel shall be under tension to operate properly.

5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non expert personnel.

5. Boom Control Interface



Drawing 1.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

Auto mode / Manual mode:
The operator selects auto mode or manual mode using the rocker switch in the dash board. Auto mode is the working mode and manual mode is used for rigging or sequencing purpose only.

Pilot pressure switch signal / Analog output signal:
Two pressure switches in the pilot pressure circuit are used to distinguish between boom extend or boom retract. The two circuits are wired through the crane interface connector into the DS 350 G central unit.

When the operator extends the boom, the pressure switch signal at central unit terminal A101-X1/38 changes from 0V to +24V. The boom control logic allows electrical current to flow to the extend pressure reducing valve coil. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 800 mA.
To measure the coil current while extending, remove wire #20from central unit terminal A101-X1/63. Connect the Amp-meter in series with wire #20 to terminal X1/63.

When the operator retracts the boom, the pressure switch signal at central unit terminal A101-X1/40 changes from 0V to +24V. The boom control logic allows electrical current to flow to the retract pressure reducing valve coil. The minimum current equals 0 mA with the control in neutral position. The maximum current output equals 800 mA.
To measure the coil current while retracting, remove wire #21 from central unit terminal A101-X1/64. Connect the Amp-meter in series with wire #21 to terminal X1/64.

Length sensors:
Three length sensors are mounted to the boom base section to measure the overall length, the inner mid section length and the center mid section length. The software utilizes the signals to calculate the outer mid and fly section length.

Disengage the boom stop to retract the boom completely.

With retracted main boom the overall boom length signal is -500 mV (A101-X1/10). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground. Disengage the boom stop to retract the boom completely.

With retracted main boom the inner mid section length signal is -500 mV (A101-X1/24). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

With retracted main boom the center mid section length signal is -500 mV (A101-X1/73). Use the test pin MP 15 (AGND) or terminal A101-X1/8 (AGND) for reference ground.

Keep the cable on the length transducer drum spooled properly. A poorly spooled cable may causes the boom to become out of sequence. If the boom becomes out of sequence, select manual mode and correct the length by operating individual sections. Once the sections are sequenced again the operator may return to the automode. Refer to section 9.1 for boom components installation and set up.

Inner mid retract and % reset switch:
The reset- proximity switch on the base section provides a (+24V) signal to central unit terminal A 104 X1/80 when the inner mid section is retracted against the boom stop. The signal resets the inner mid percentage to 1%.

The retract- proximity switch on the base section provides a (+24V) signal to central unit terminal A 104 X1/78 when the inner mid section is fully retracted (disengage the boom stop).

Center mid retract and % reset switch:
The proximity switch on the inner mid section provides a (+24V) signal to central unit terminal A 114 X1/9 when the center mid section is fully retracted. The signal resets the center mid percentage to 0%.

Refer to Parts & Installation Manual and follow the installation instructions for switch and target adjustment.

Outer mid/ fly retract and % reset switch:
The proximity switch on the center mid section provides a (+24V) signal to central unit terminal A 114 X1/76 when the outer mid and fly section is fully retracted. The signal resets the outer mid/ fly percentage to 0%.

Refer to Parts & Installation Manual and follow the installation instructions for switch and target adjustment.

System inputs:

DI #	Description	Central Unit Terminal	Signal (DI=on)
1 MB	Pressure switch - boom extend GND	A104 - X1/38 A104 - X1/37	+24V 0V
2 MB	Pressure switch -boom retract GND	A104 - X1/40 A104 - X1/39	+24V 0V
3 MB	Automode switched on GND	A104 - X1/42 A104 - X1/41	+24V 0V
4 MB	Outer mid/ fly retract and % switch GND	A104 - X1/76 A104 - X1/75	+24V 0V
5 MB	Inner mid retract switch GND	A104 - X1/78 A104 - X1/77	+24V 0V
6 MB	Inner mid % reset switch GND	A104 - X1/80 A104 - X1/79	+24V 0V
1 EX	House lock engaged (RT 865 BXL-- Europe) * GND	A114 - X1/1 A114 - X1/2	+24V 0V
2 EX	Automode A = on; Automode B = off * GND	A114 - X1/3 A114 - X1/4	+24V 0V
3 EX	+ Ub (24V) Front outrigger overload (GND)	A114 - X1/5 A114 - X1/6	+24V 0V
4 EX	Area def. switch (RT 865 BXL) * GND	A114 - X1/7 A114 - X1/8	+24V 0V
5 EX	Center mid retract and % reset switch GND	A114 - X1/9 A114 - X1/10	+24V 0V

Note: MB = main board
EX = extension board

** = RT 865 BXL only*

Output for two- way valves:

A pair of two- way valves controls the oil to each tele- cylinder. The relay output K2, K6, K7 operates the pair of two- way valves in automode. The valve need to be de-energized to operate the particular cylinder. The valves for the sections that are not selected are powered to prevent movement of the other cylinders.

Mode	Relay K2 [V]	IM 2 way valves	Relay K6 [V]	CM 2 way valves	Relay K7 [V]	OM 2 way valves
	A104-X1/54		A104-X1/66		A104-X1/69	
Auto IM	0	0	24	1	24	1
Auto CM	24	1	0	0	24	1
Auto OM	24	1	24	1	0	0
Manual IM	0	0 *	0	1 *	0	1 *
Manual CM	0	1 *	0	0 *	0	1 *
Manual OM	0	1 *	0	1 *	0	0 *
Error (Auto)	24	1	24	1	24	1
Neutral (Auto)	24	1	24	1	24	1

*Note: * = powered directly from the section selector switch in the cabin.*

Relay outputs:

Relay	Fuse	Description	Central Unit Terminal	Signal
K1	F2	not used not used		
K2	F3	Inner mid two way- valves GND	A104 - X1/54 A104 - X1/3	+24V 0V
K3	F4	Rod side dump valve GND	A104 - X1/57 A104 - X1/3	+24V 0V
K4	F5	Tele out of sequence - Warning light in cabin GND	A104 - X1/61 A104 - X1/3	+24V 0V
K5 K5 K5	F6	Signal from analog output board Directs the analog signal to the extend valve Directs the analog signal to the retract valve	A104 - X1/62 A104 - X1/63 A104 - X1/64	0-800mA 0-800mA 0-800mA
K6 K6	F7	Center mid two way- valves GND	A104 - X1/66 A104 - X1/3	+24V 0V
K7	F8	Outer mid two way- valves GND	A104 - X1/69 A104 - X1/3	+ 24V 0V
K8	none	Internal LMI use (overload, error)	A104 - X1/44	+ 24V
K9	none	Internal LMI use (A2B)	A104 - X1/46	+ 24V
K10	external	Motion cut (Bosch relay)	A104 - X1/48	+ 24V

Rod side dump valve:

Relay K3 controls the rod side dump valve. The valve dumps the rod side pressure when the controller is in neutral position and during the time the section stops while changing over to another section.

Controller	**Relay K3 A101 x1/ 57**
Extend on	0V
Retract on	0V
Neutral	+24V
Retracted/ retract on	+24V

6. Boom Sequence

Main Boom:

Mode	IM %	CM %	OM %	FLY %
Auto B	0	0	0	0
Auto B	50	0	0	0
Auto B	50	50	0	0
Auto B	75	50	0	0
Auto B	75	75	0	0
Auto B	100	75	0	0
Auto B	100	100	0	0
Auto B	100	100	100	100

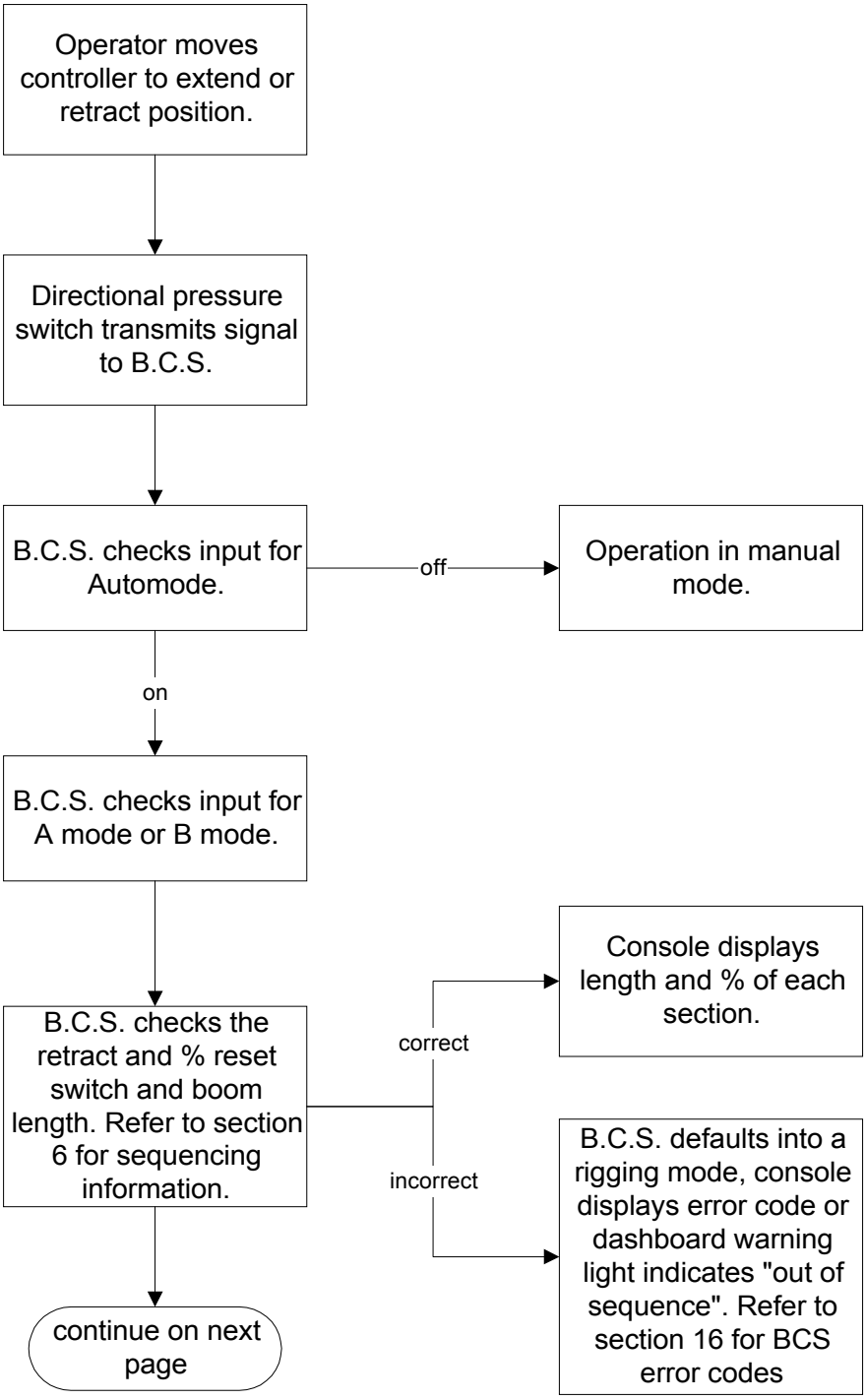
Mode	IM %	CM %	OM %	FLY %
Auto A *	0	0	0	0
Auto A *	0	100	0	0
Auto A *	0	100	100	100
Auto A *	100	100	100	100

*= Mode A not available on RT 865 BXL

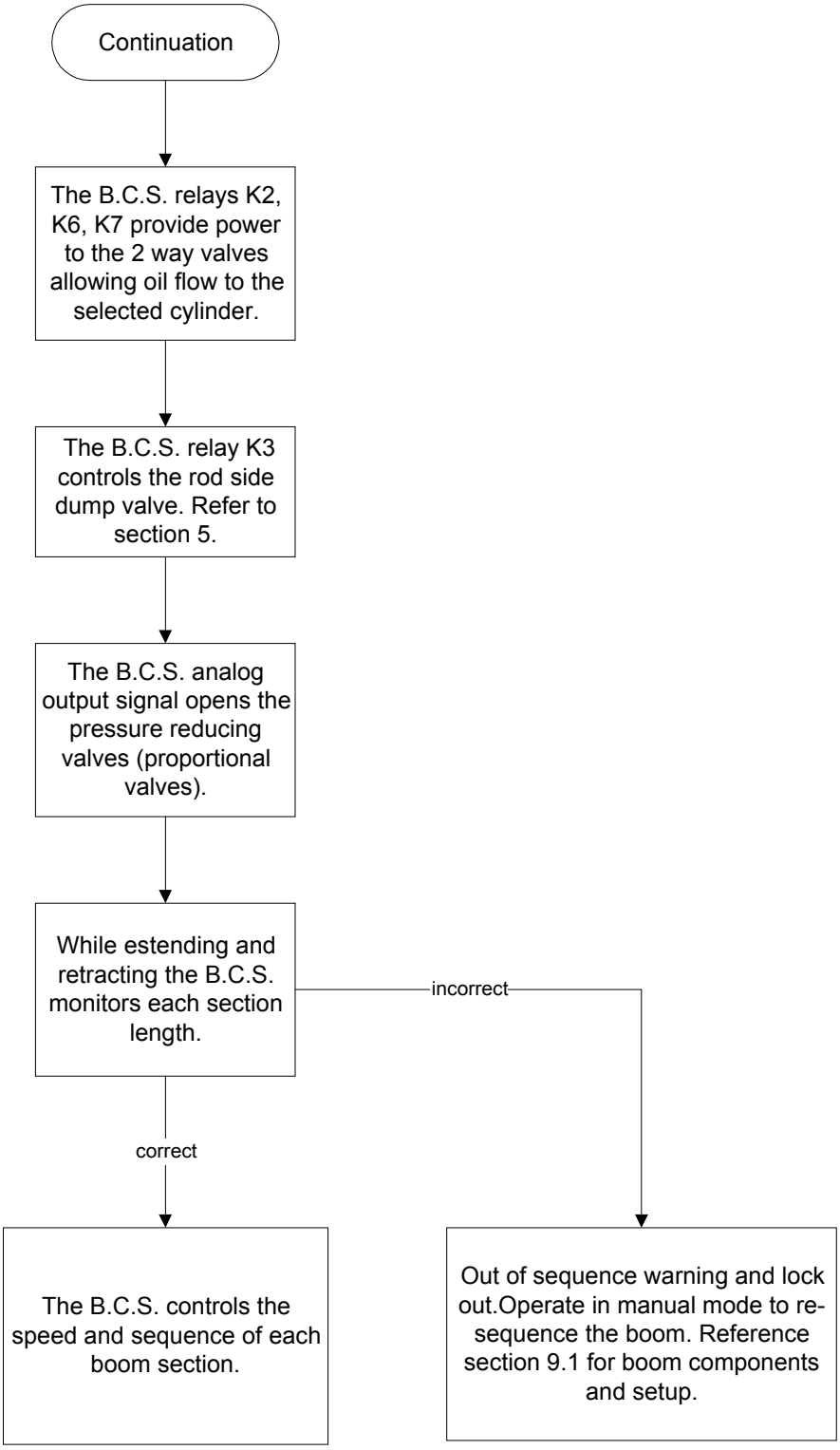
Extensions:

Mode	IM %	CM %	OM %	FLY %
Auto	0	0	0	0
Auto	100	0	0	0
Auto	100	100	0	0
Auto	100	100	100	100

7. Boom Control Flow

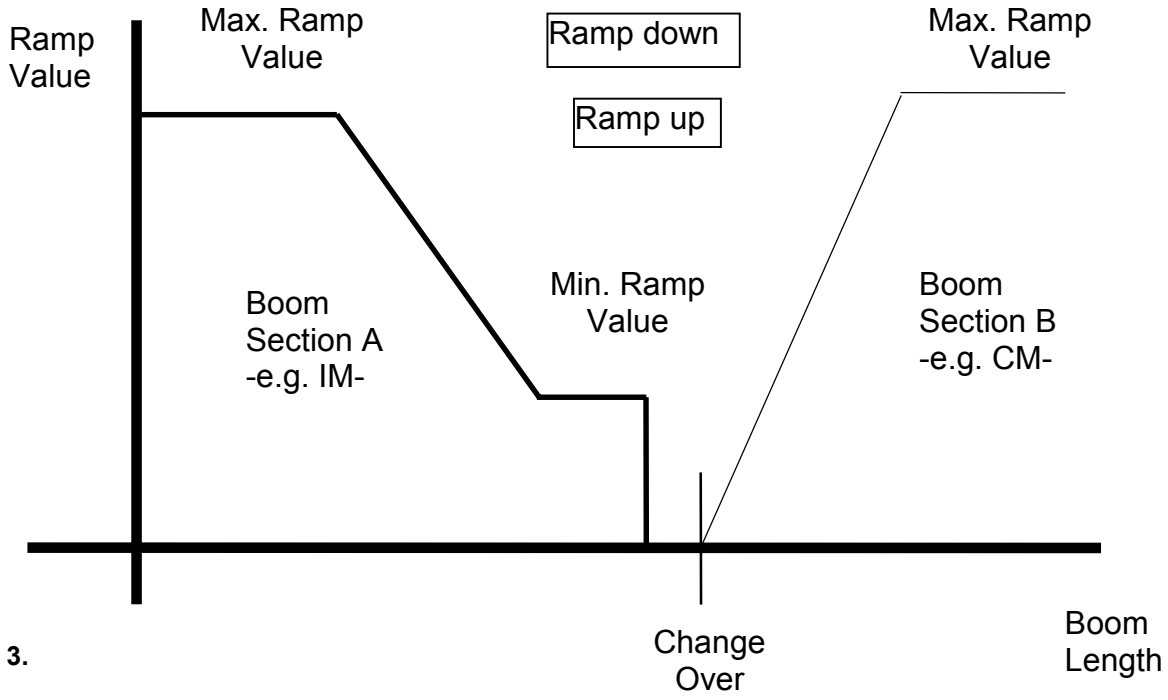

Operator moves controller to extend or retract position.
Directional pressure switch transmits signal to B.C.S.
B.C.S. checks input for Automode.
off
Operation in manual mode.
on
B.C.S. checks input for A mode or B mode.
B.C.S. checks the retract and % reset switch and boom length. Refer to section 6 for sequencing information.
correct
Console displays length and % of each section.
incorrect
B.C.S. defaults into a rigging mode, console displays error code or dashboard warning light indicates "out of sequence". Refer to section 16 for BCS error codes
continue on next page

Drawing 2a.


Continuation
The B.C.S. relays K2, K6, K7 provide power to the 2 way valves allowing oil flow to the selected cylinder.
The B.C.S. relay K3 controls the rod side dump valve. Refer to section 5.
The B.C.S. analog output signal opens the pressure reducing valves (proportional valves).
While estending and retracting the B.C.S. monitors each section length.
incorrect
correct
The B.C.S. controls the speed and sequence of each boom section.
Out of sequence warning and lock out.Operate in manual mode to re-sequence the boom. Reference section 9.1 for boom components and setup.

Drawing 2b.

8. Ramping



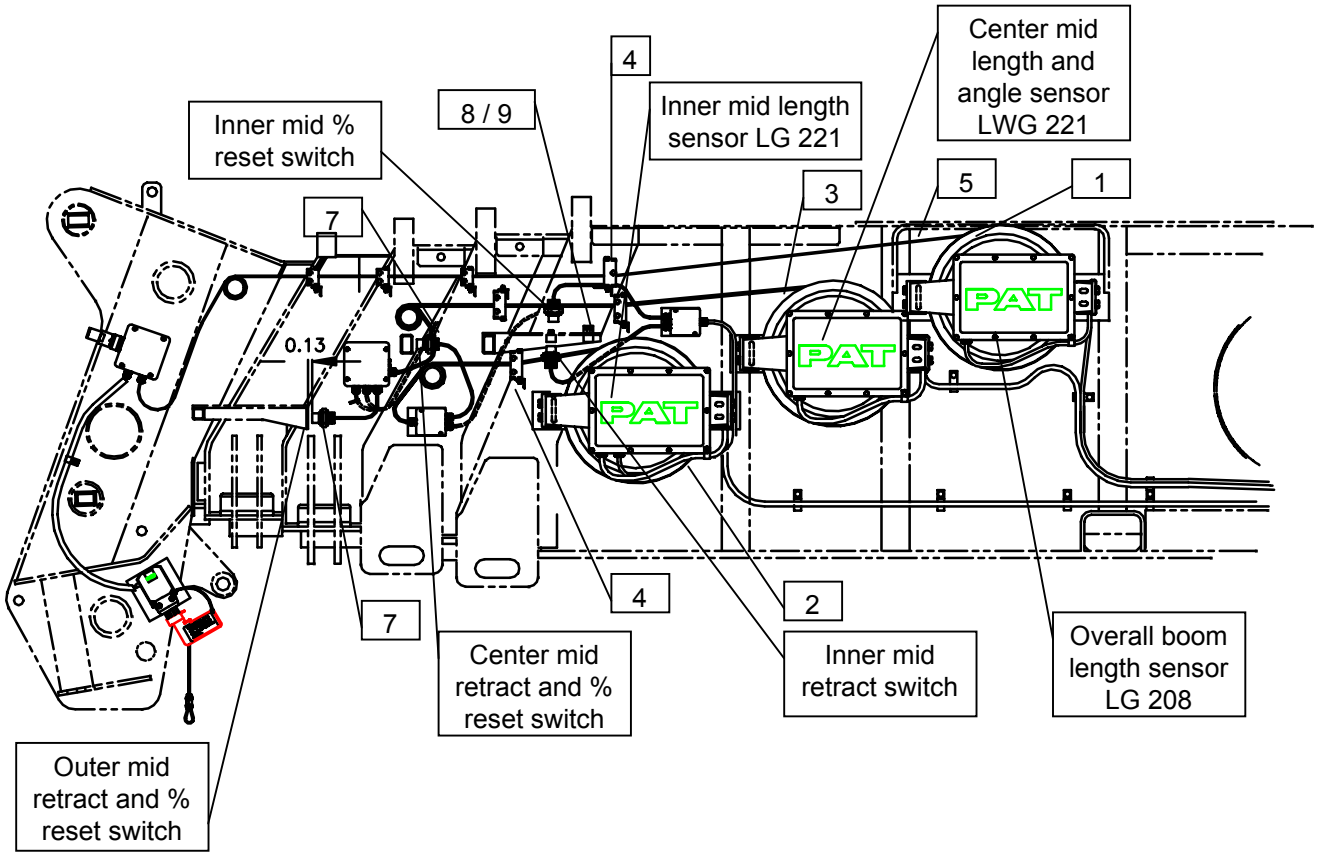
Drawing 3.

Ramp value:	A hex value in the software which determines the output current to the proportional valve.
Max. ramp value:	The maximum hex value (hex 255) equals to 800 mA valve (pressure reducing valve). This current is required to open the valve for maximum tele speed.
Min. ramp value:	The minimum hex value that is required to move a section in the ramping area. These values may differ for each ramping area.
Change over:	The previous section comes to a complete stop and the next section ramps up (accelerates speed).

IM:	Inner Mid Section
CM:	Center Mid Section
OM/Fly:	Outer Mid Section & Fly

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

9.1 DS 350 G - Boom Components and Setup



Drawing 4.

1. Pre-tension the cable reel spring by rotating drum (16) revolution counterclockwise. If replacing the LG 208 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

2. Pre-tension the cable reel spring by rotating drum (35) revolution counterclockwise. If replacing the LG 221 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

3. Pre-tension the cable reel spring by rotating drum (30) revolution counterclockwise. If replacing the LWG 221 un-spool the length cable and secure to bushing on the boom nose as noted in the installation drawing. Zero the length potentiometer as described on page 18.

4. Run cable through the cable guides. Remove 1/4-20 nuts on bottom of cable guide, insert cable guide screws through existing angle bracket and secure in place with 1/4-20 nuts removed previously.

5. Center line of cable must be aligned with center line of cable drum. See partial top view.

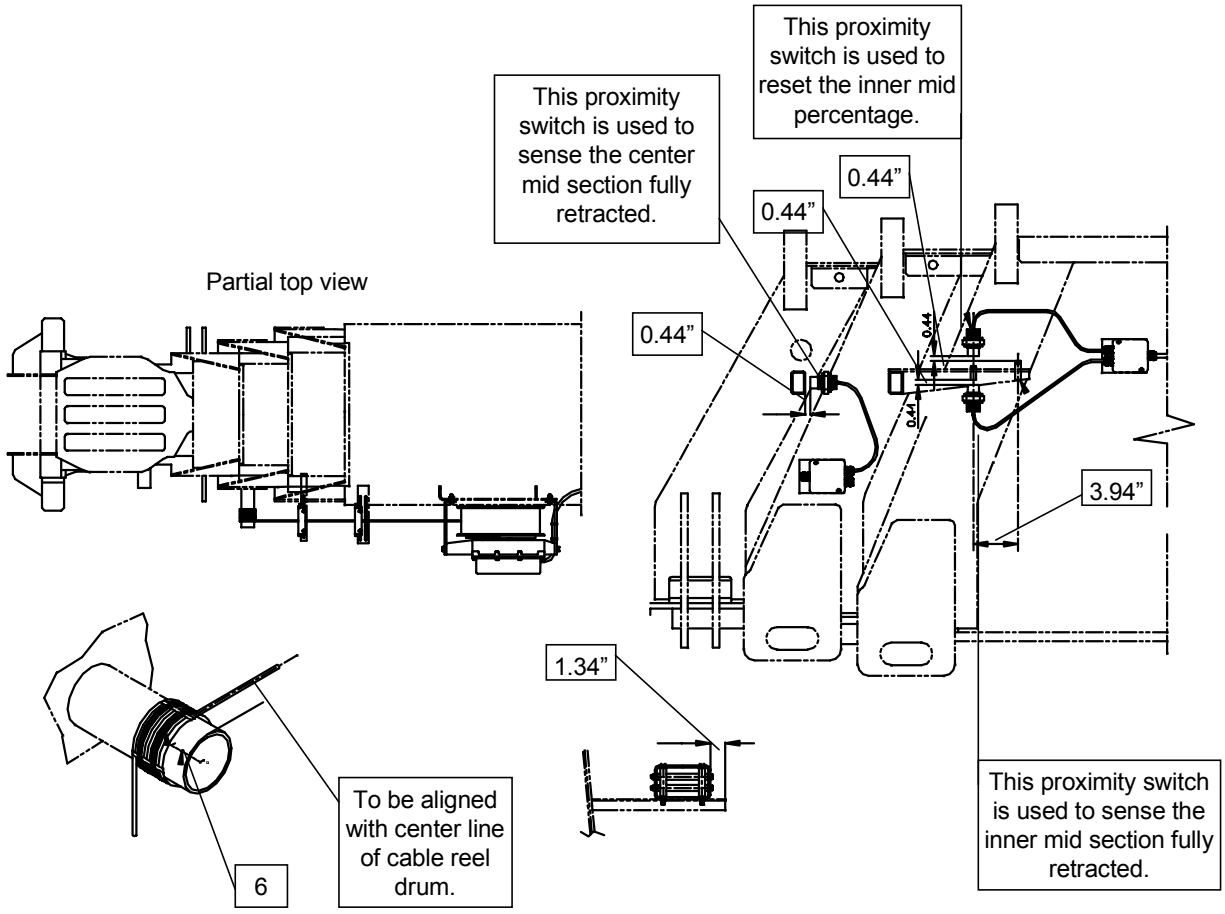
PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

1. Place tie wrap, 120 degree apart around the bushing. Wrap cable (8-10) revolutions over the tie wraps starting from the outside and working inward. Allow ample cable to reach the junction box. Secure with (2) additional tie wraps. See page 17.

2. Check proximity switch installation (0.44 inch from target) when boom sections are fully retracted.

3. This target is only installed if the boom is equipped with a boom extension stop block.

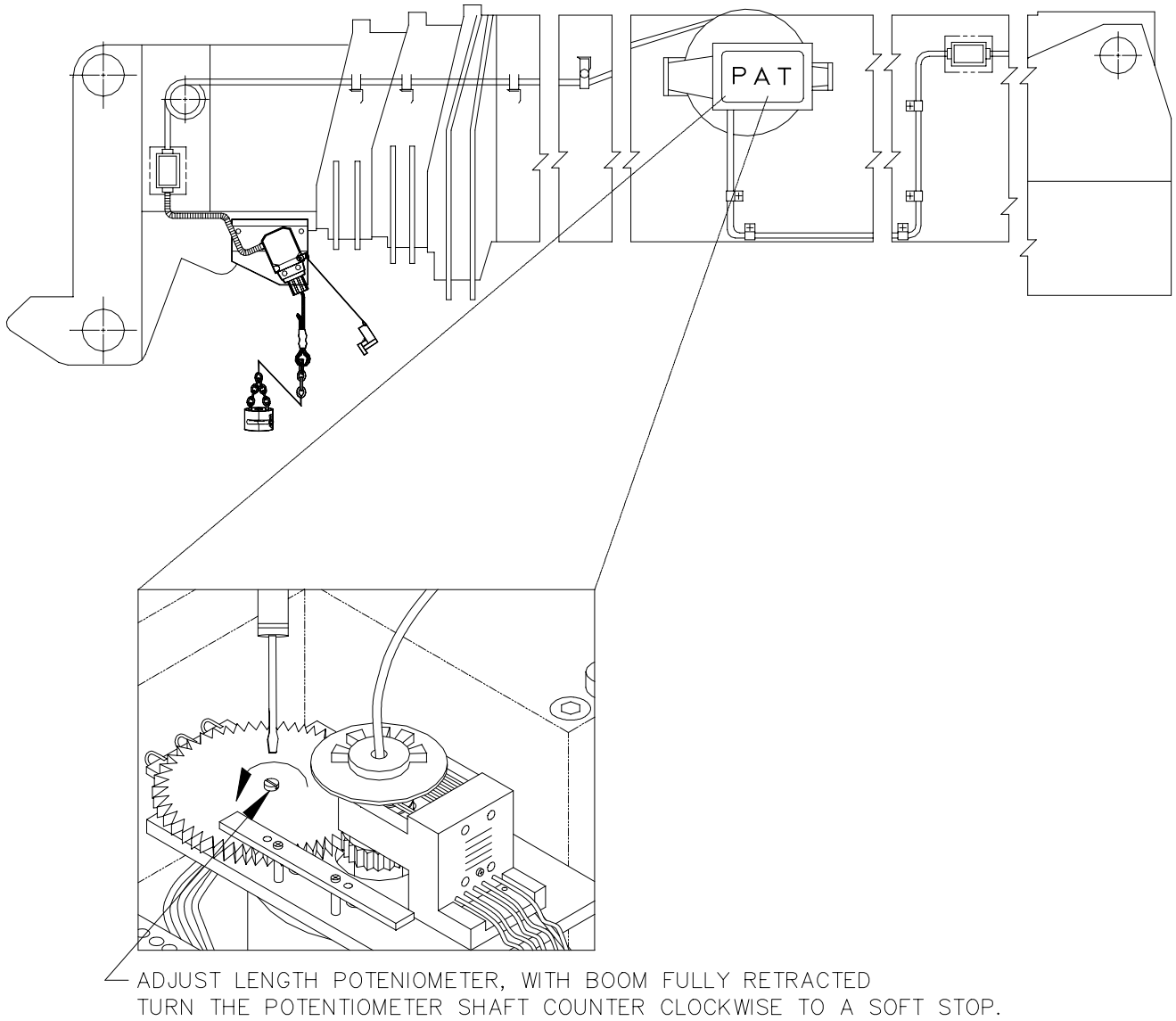
4. Check this proximity switch installation (0.13 inch from target) when boom sections are fully retracted.


This proximity switch is used to reset the inner mid percentage.
This proximity switch is used to sense the center mid section fully retracted.
0.44”
0.44”
Partial top view
0.44”
3.94”
1.34”
To be aligned with center line of cable reel drum.
6
This proximity switch is used to sense the inner mid section fully retracted.

Drawing 5.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

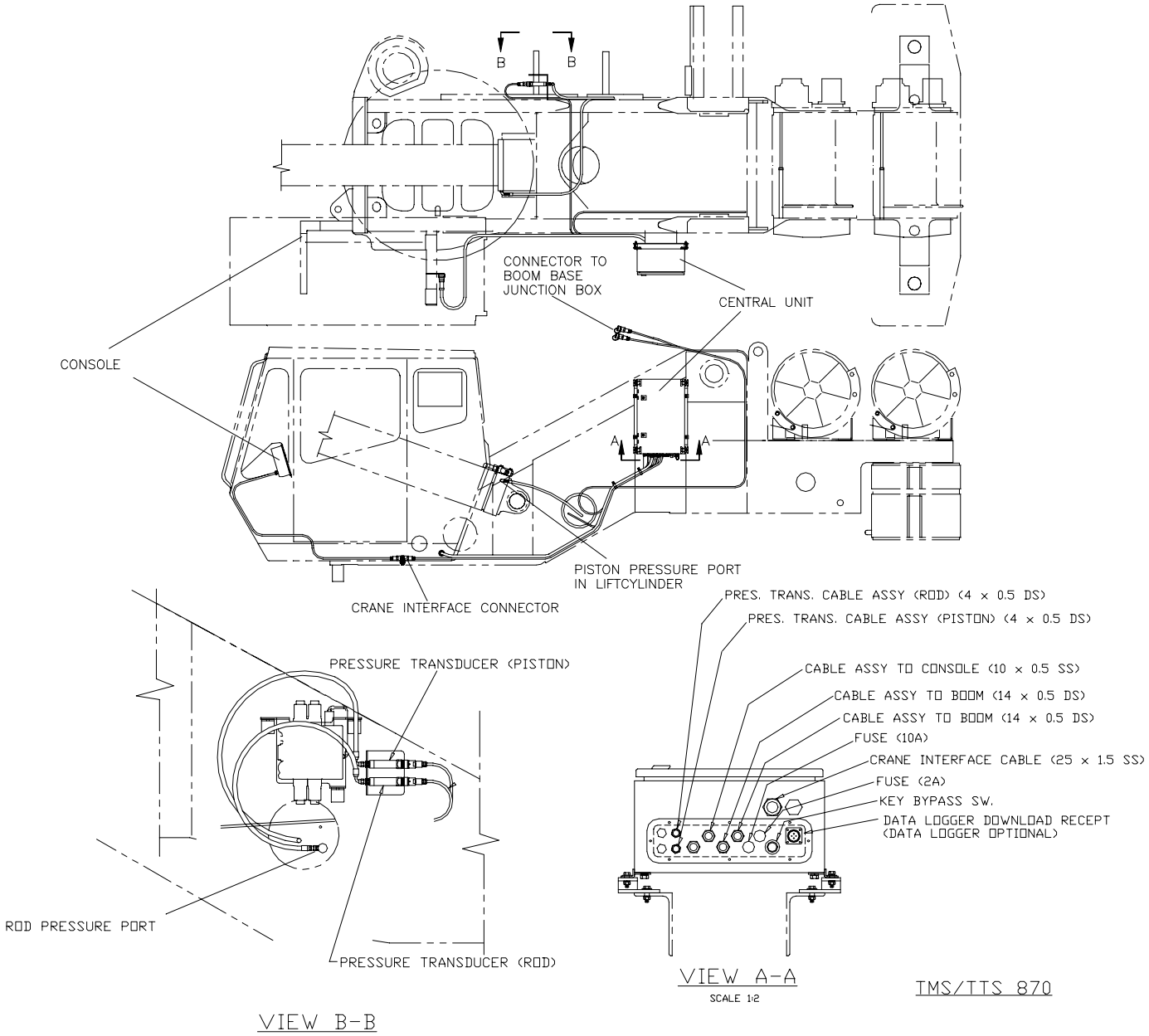
9.2 Length Transducer Adjustment


PAT
ADJUST LENGTH POTENIOMETER, WITH BOOM FULLY RETRACTED
TURN THE POTENTIOMETER SHAFT COUNTER CLOCKWISE TO A SOFT STOP.

Drawing 6.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

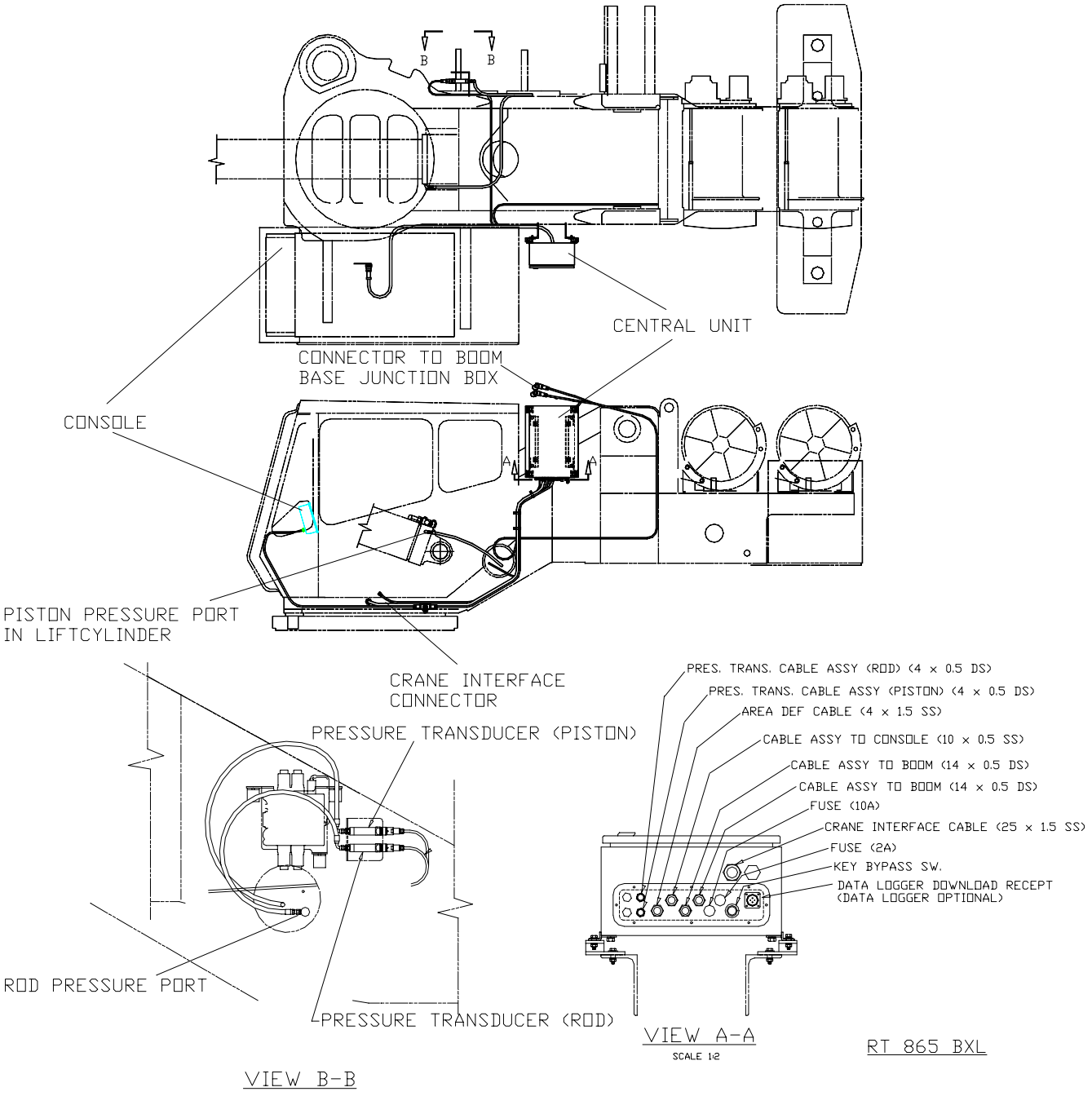
9.3 DS 350 G Superstructure Components - TMS/TTS 870



Drawing 7.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

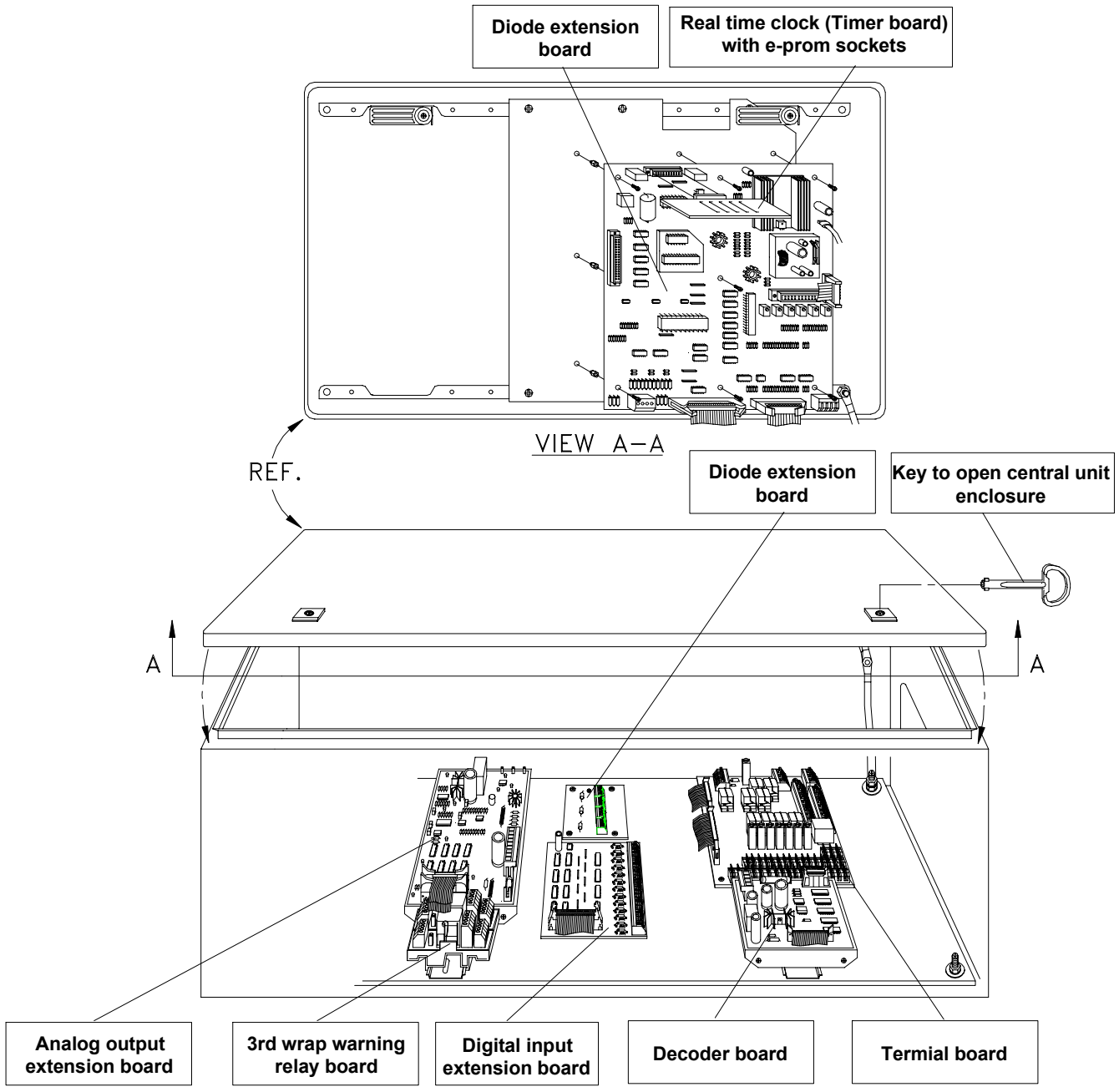
9.4 DS 350 G Superstructure Components - RT 865 BXL



Drawing 8.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

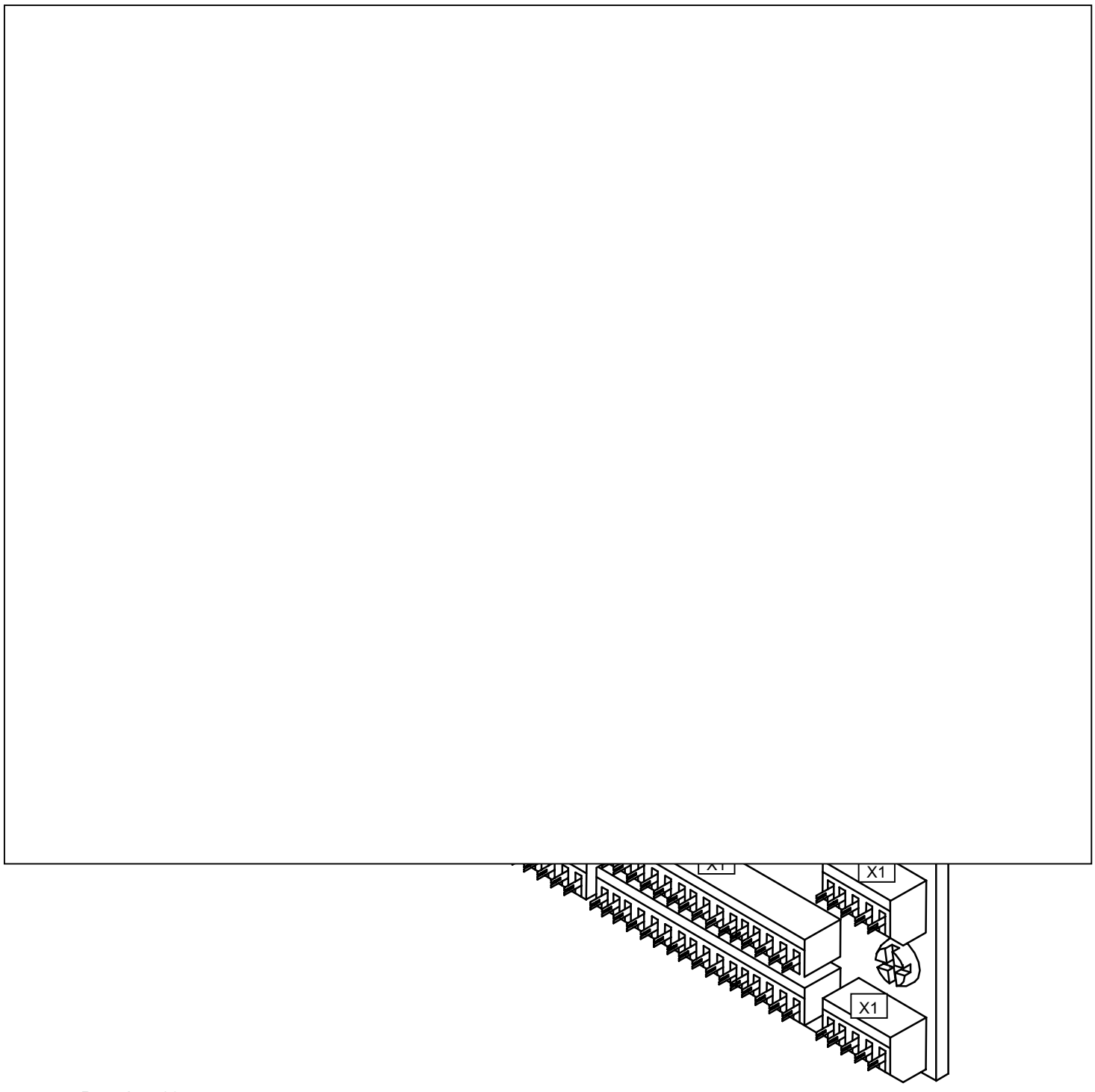
10.1 DS 350 G LMI central unit (751) - TMS/TTS 870 & RT 865 BXL



Drawing 9.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

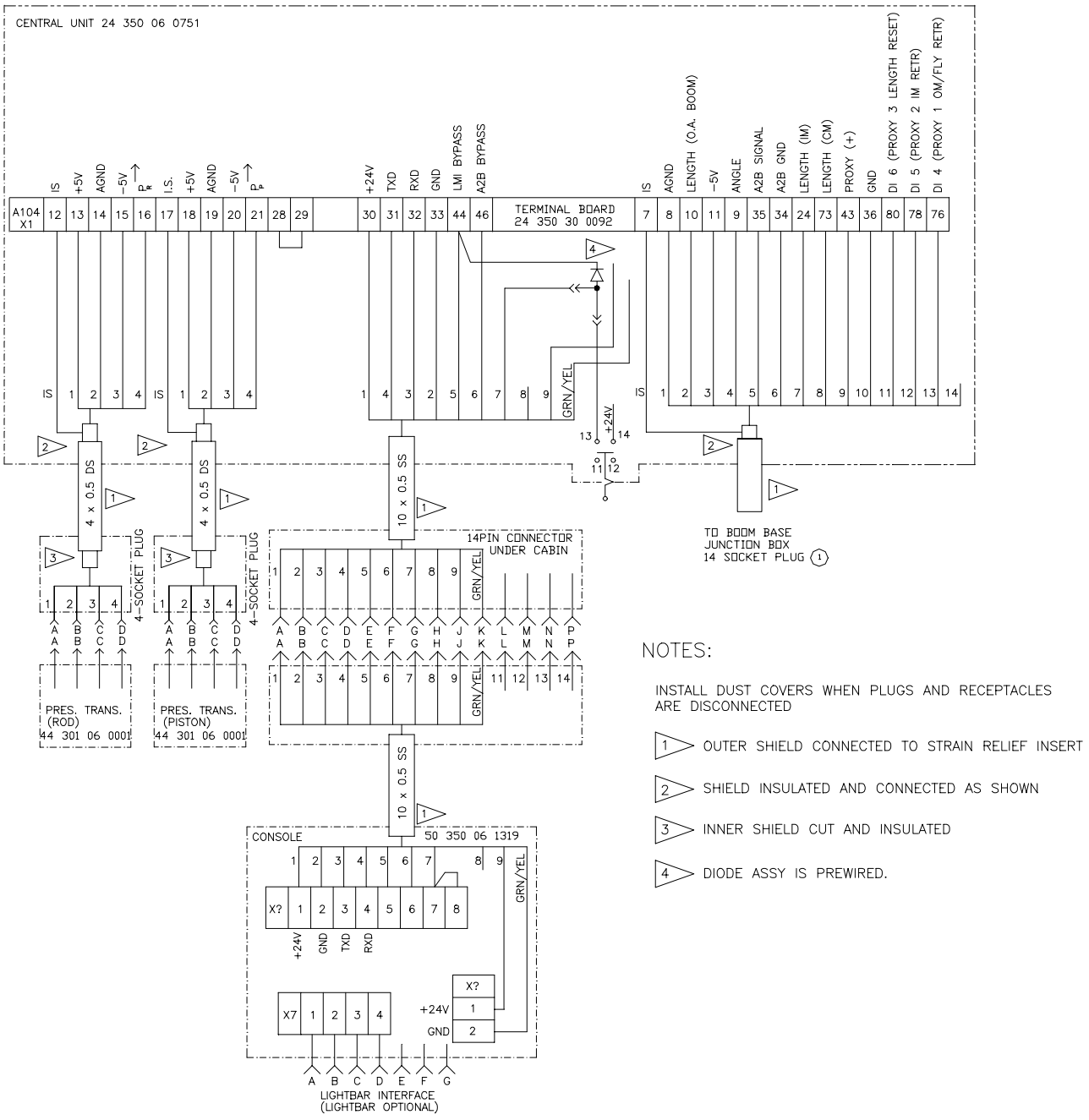
10.2 LMI Terminal board - TMS 870, TTS 870 and RT 865 BXL



Drawing 10.

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

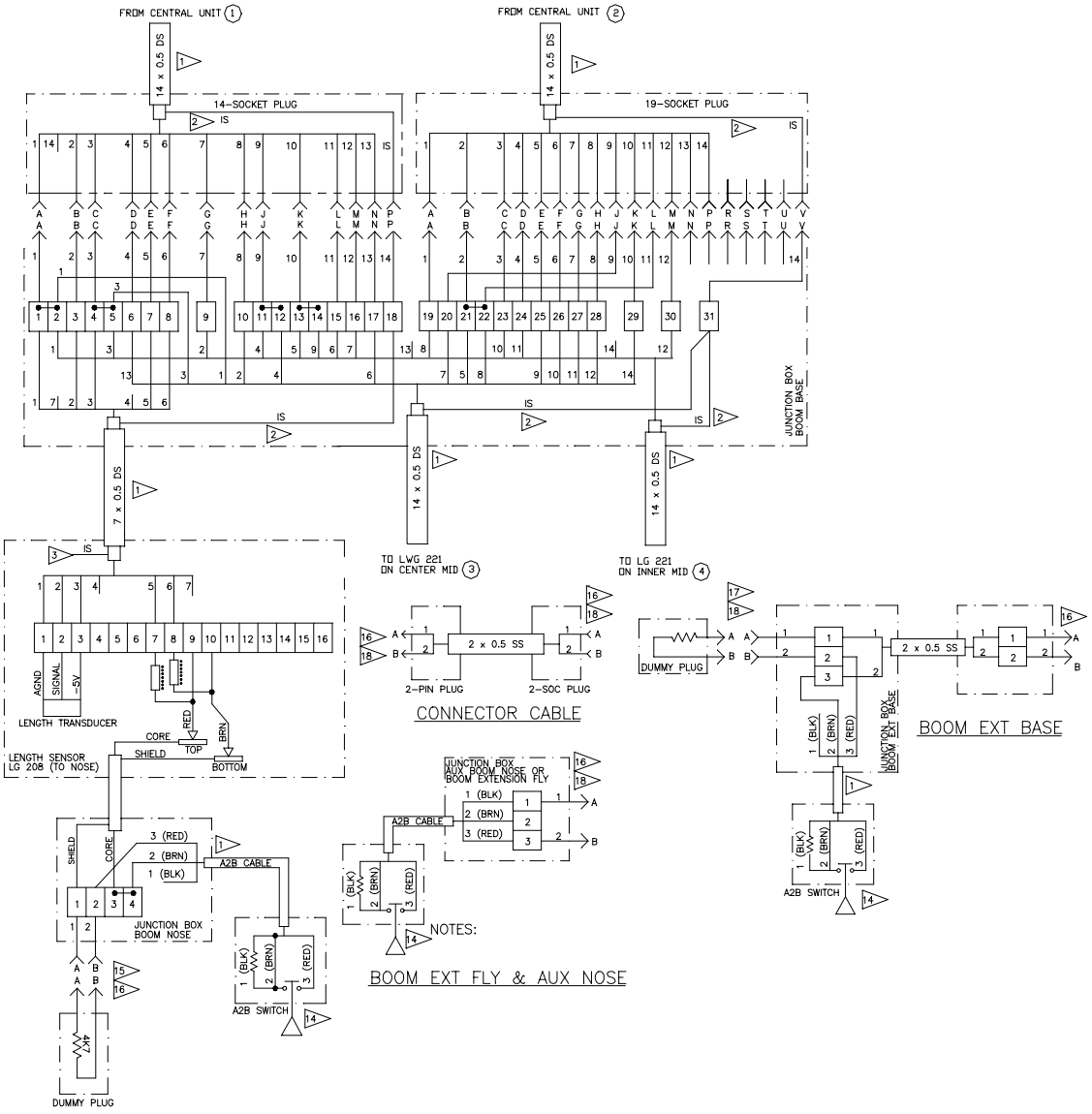
11.1 Wiring Schematic - TMS 870/ TTS 870



Drawing 11.1

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

11.1 Wiring Schematic - TMS 870/ TTS 870



NOTES:

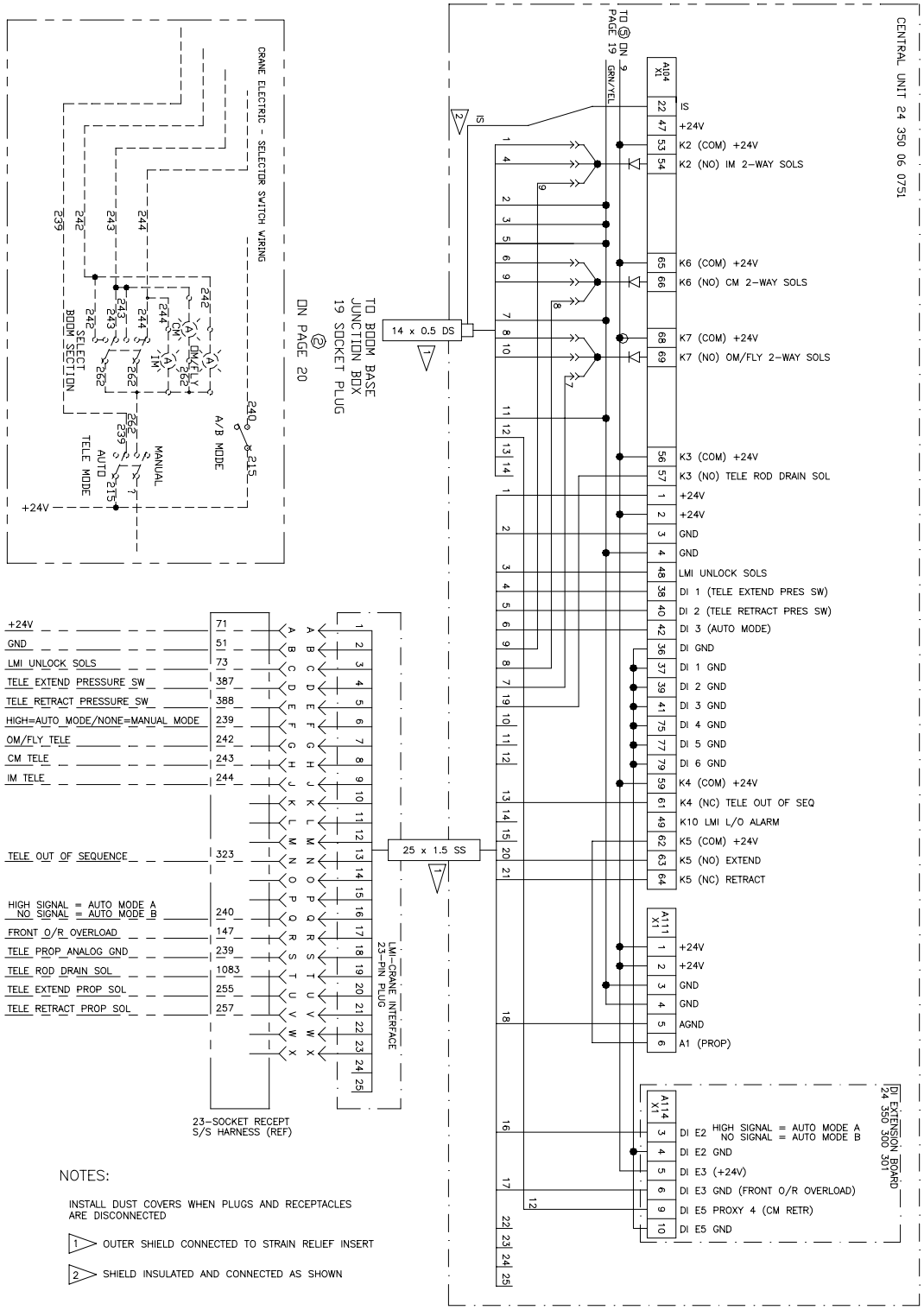
INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES
13. RELAY AND DIODE ASSY ARE PREWIRED
14. A2B SWITCH IS PREWIRED & POTTED
15. WHEN BOOM EXT OR AUX NOSE IS NOT USED, INSTALL DUMMY PLUG INTO RECEPT ON BOOM NOSE JUNCTION BOX
16. WHEN BOOM EXT OR AUX BOOM NOSE IS USED, INSTALL CONNECTOR CABLE FROM RECEPT ON BOOM NOSE JUNCTION BOX TO RECEPT ON BOOM EXT OR AUX NOSE JUNCTION BOX
17. WHEN BOOM EXT BASE IS USED WITHOUT FLY, INSTALL DUMMY PLUG INTO RECEPT ON BOOM EXT BASE JUNCTION BOX
18. WHEN BOOM EXT FLY IS USED, INSTALL 2nd CONNECTOR CABLE FROM RECEPT ON BOOM EXT BASE JUNCTION BOX TO RECEPT ON BOOM EXT FLY JUNCTION BOX

Drawing 11.2

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

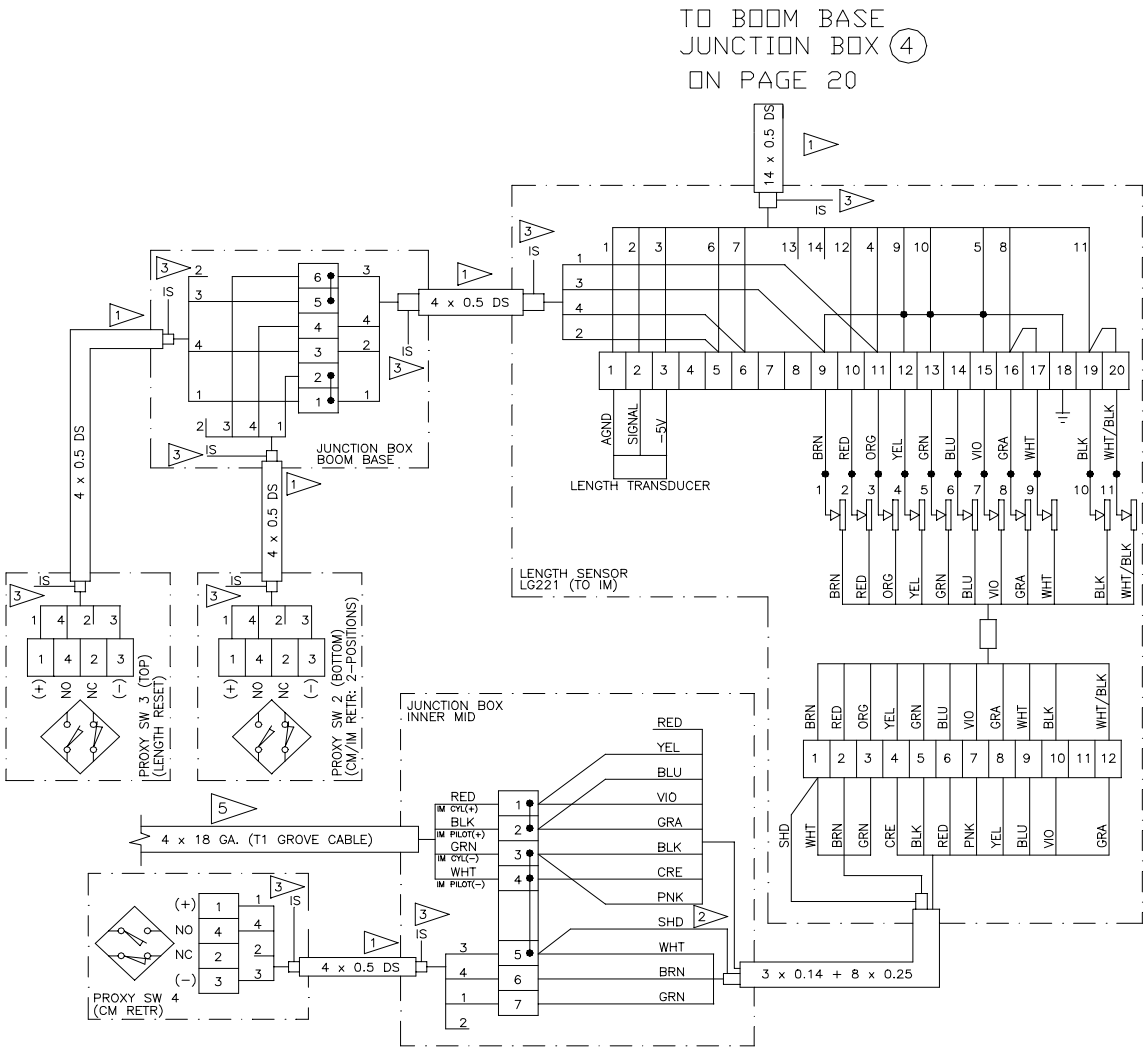
11.1 Wiring Schematic - TMS 870/ TTS 870


CRANE ELECTRIC - SELECTOR SWITCH WIRING
BOOM SECTION SELECT
TELE MODE
AUTO
MANUAL
A/B MODE
+24V
TO BOOM BASE JUNCTION BOX 19 SOCKET PLUG
DN PAGE 20
TO DN PAGE 19
14 x 0.5 DS
25 x 1.5 SS
LMI-CRANE INTERFACE 23-PIN PLUG
23-SOCKET RECEPT S/S HARNESS (REF)
CENTRAL UNIT 24 350 06 0751
A104 X1
A111 X1
A114 X1
DI EXTENSION BOARD 24 350 300 301
+24V
GND
LMI UNLOCK SOLS
TELE EXTEND PRESSURE SW
TELE RETRACT PRESSURE SW
HIGH=AUTO MODE/NONE=MANUAL MODE
OM/FLY TELE
CM TELE
IM TELE
TELE OUT OF SEQUENCE
HIGH SIGNAL = AUTO MODE A
NO SIGNAL = AUTO MODE B
FRONT O/R OVERLOAD
TELE PROP ANALOG GND
TELE ROD DRAIN SOL
TELE EXTEND PROP SOL
TELE RETRACT PROP SOL
K2 (COM) +24V
K2 (NO) IM 2-WAY SOLS
K6 (COM) +24V
K6 (NO) CM 2-WAY SOLS
K7 (COM) +24V
K7 (NO) OM/FLY 2-WAY SOLS
K3 (COM) +24V
K3 (NO) TELE ROD DRAIN SOL
DI 1 (TELE EXTEND PRES SW)
DI 2 (TELE RETRACT PRES SW)
DI 3 (AUTO MODE)
K4 (COM) +24V
K4 (NC) TELE OUT OF SEQ
K10 LMI L/O ALARM
K5 (COM) +24V
K5 (NO) EXTEND
K5 (NC) RETRACT
AGND
A1 (PROP)
DI E2 HIGH SIGNAL = AUTO MODE A NO SIGNAL = AUTO MODE B
DI E2 GND
DI E3 (+24V)
DI E3 GND (FRONT O/R OVERLOAD)
DI E5 PROXY 4 (CM RETR)
DI E5 GND
NOTES:
INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED
1 OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2 SHIELD INSULATED AND CONNECTED AS SHOWN

Drawing 11.3

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

11.1 Wiring Schematic - TMS 870/ TTS 870



NOTES:

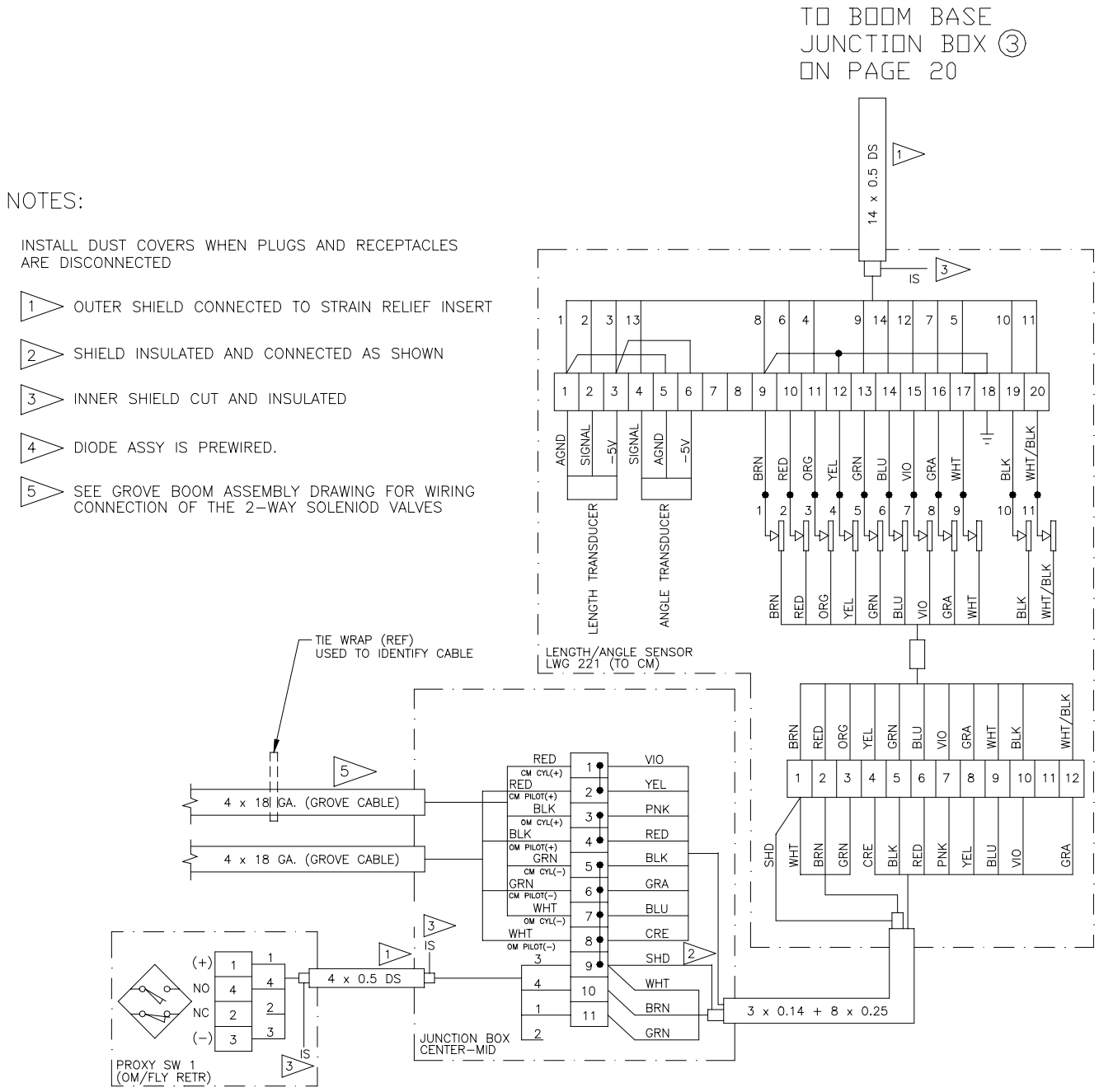
INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES

Drawing 11.4

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

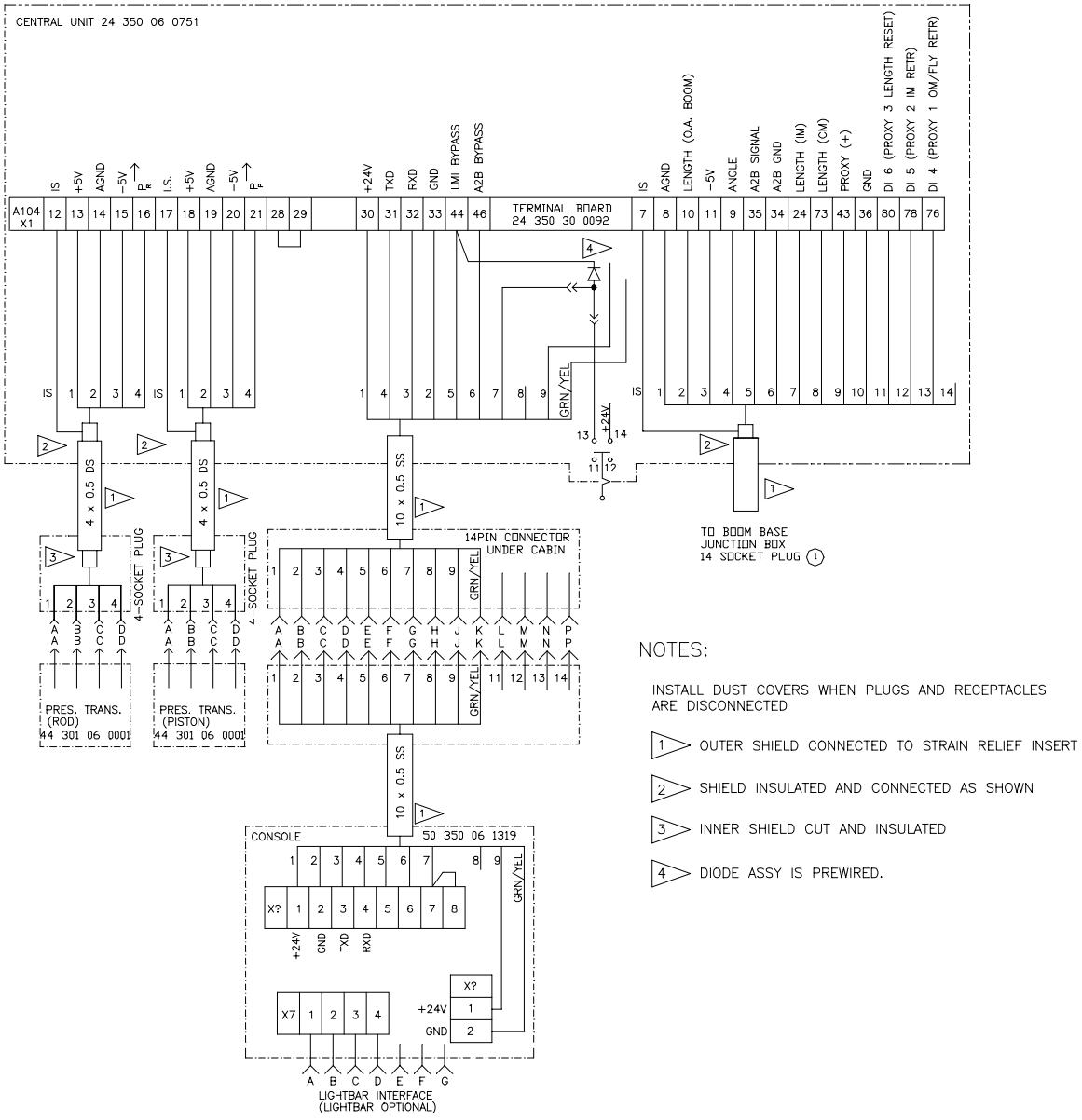
11.1 Wiring Schematic - TMS 870/ TTS 870



Drawing 11.5

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

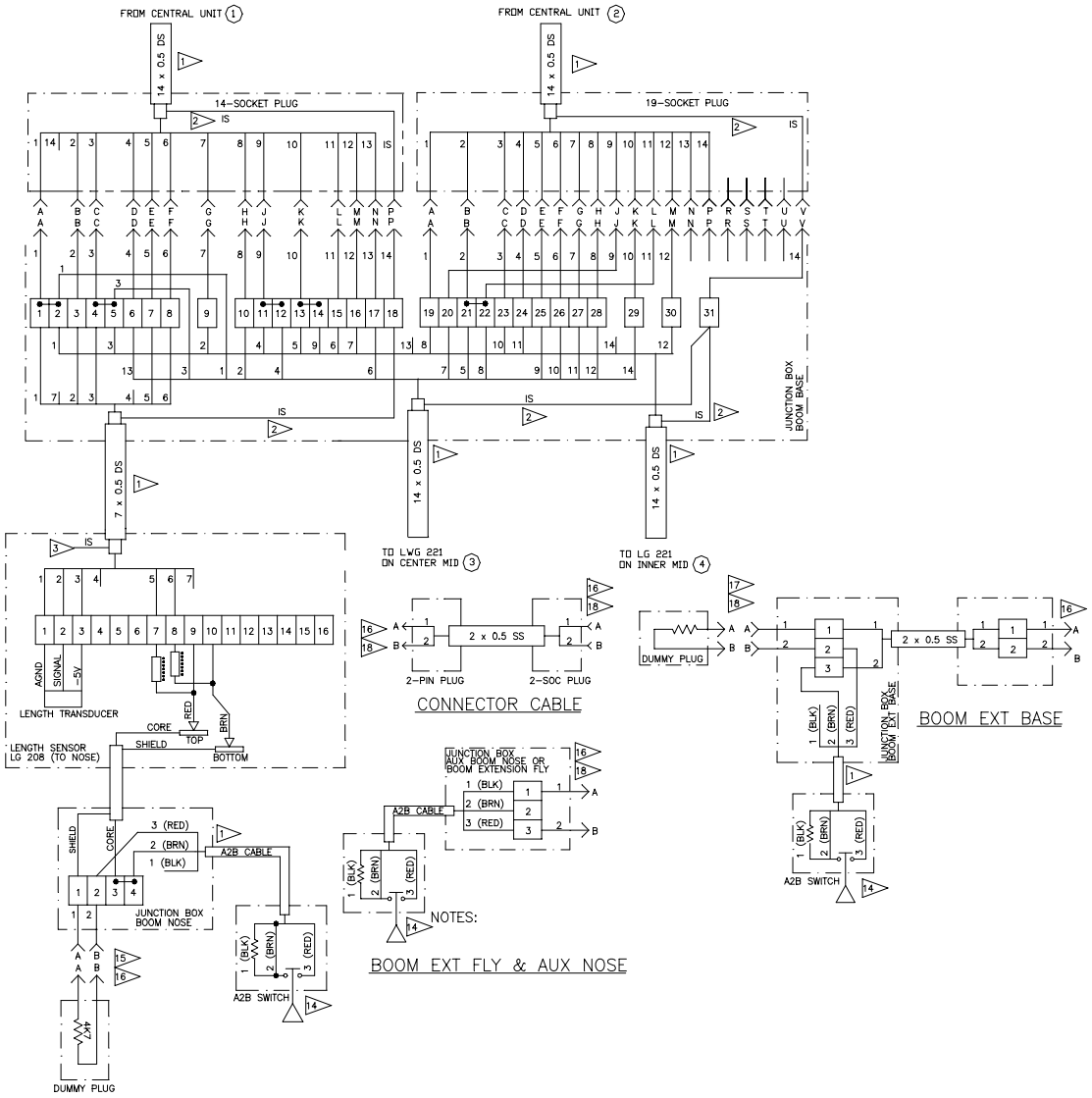
11.2 Wiring Schematic - RT 865 BXL



Drawing 12.1

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

11.2 Wiring Schematic - RT 865 BXL



NOTES:

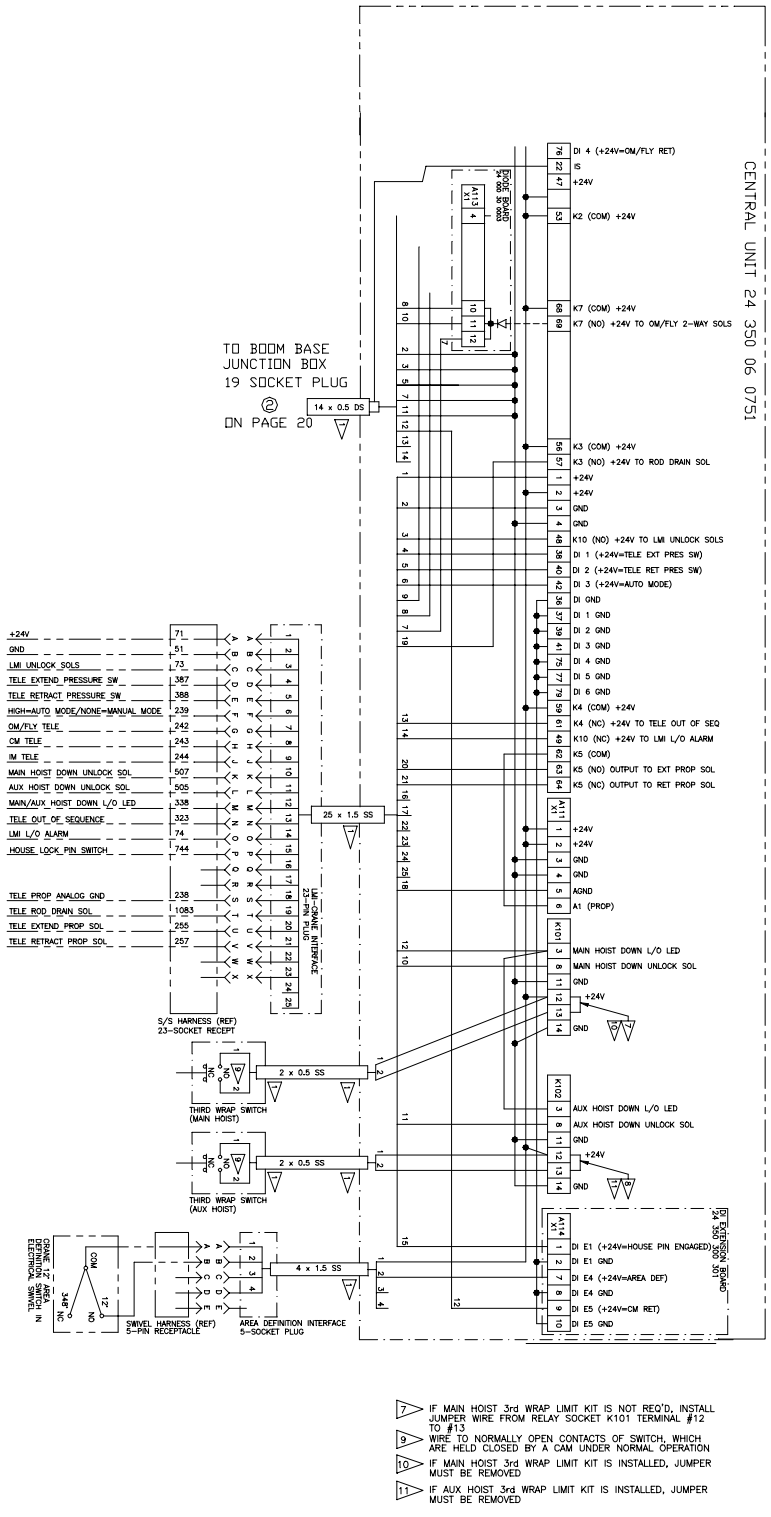
INSTALL DUST COVERS WHEN PLUGS AND RECEPTACLES ARE DISCONNECTED

1. OUTER SHIELD CONNECTED TO STRAIN RELIEF INSERT
2. SHIELD INSULATED AND CONNECTED AS SHOWN
3. INNER SHIELD CUT AND INSULATED
4. DIODE ASSY IS PREWIRED.
5. SEE GROVE BOOM ASSEMBLY DRAWING FOR WIRING CONNECTION OF THE 2-WAY SOLENIOD VALVES
13. RELAY AND DIODE ASSY ARE PREWIRED
14. A2B SWITCH IS PREWIRED & POTTED
15. WHEN BOOM EXT OR AUX NOSE IS NOT USED, INSTALL DUMMY PLUG INTO RECEPT ON BOOM NOSE JUNCTION BOX
16. WHEN BOOM EXT OR AUX BOOM NOSE IS USED, INSTALL CONNECTOR CABLE FROM RECEPT ON BOOM NOSE JUNCTION BOX TO RECEPT ON BOOM EXT OR AUX NOSE JUNCTION BOX
17. WHEN BOOM EXT BASE IS USED WITHOUT FLY, INSTALL DUMMY PLUG INTO RECEPT ON BOOM EXT BASE JUNCTION BOX
18. WHEN BOOM EXT FLY IS USED, INSTALL 2nd CONNECTOR CABLE FROM RECEPT ON BOOM EXT BASE JUNCTION BOX TO RECEPT ON BOOM EXT FLY JUNCTION BOX

Drawing 12.2

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

11.2 Wiring Schematic - RT 865 BXL

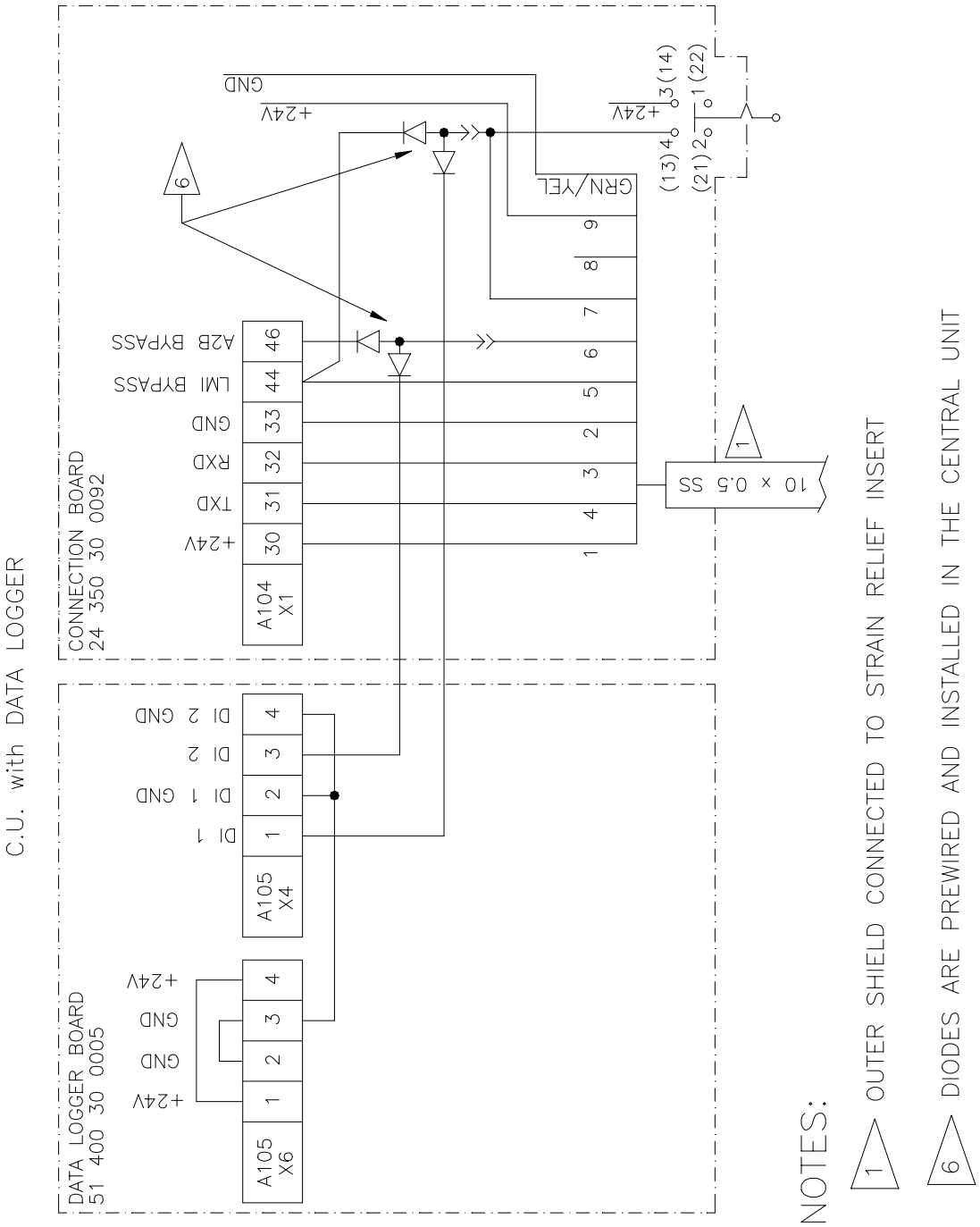

CENTRAL UNIT 24 350 06 0751
TO BOOM BASE JUNCTION BOX 19 SOCKET PLUG
@ ON PAGE 20
14 x 0.5 DS
25 x 1.5 SS
2 x 0.5 SS
2 x 0.5 SS
4 x 1.5 SS
5/S HARNESS (REF) 23-SOCKET RECEPT
23-PIN PLUG
AUTOCRANE INTERFACE
THIRD WRAP SWITCH (MAIN HOIST)
THIRD WRAP SWITCH (AUX HOIST)
SWIVEL HARNESS (REF) 5-PIN RECEPTACLE
AREA DEFINITION INTERFACE 5-SOCKET PLUG
DI 4 (+24V=OM/FLY RET)
IS
+24V
K2 (COM) +24V
K7 (COM) +24V
K7 (NO) +24V TO OM/FLY 2-WAY SOLS
K3 (COM) +24V
K3 (NO) +24V TO ROD DRAIN SOL
K10 (NO) +24V TO LMI UNLOCK SOLS
DI 1 (+24V=TELE EXT PRES SW)
DI 2 (+24V=TELE RET PRES SW)
DI 3 (+24V=AUTO MODE)
DI GND
K4 (COM) +24V
K4 (NC) +24V TO TELE OUT OF SEQ
K10 (NC) +24V TO LMI L/O ALARM
K5 (COM)
K5 (NO) OUTPUT TO EXT PROP SOL
K5 (NC) OUTPUT TO RET PROP SOL
A1 (PROP)
MAIN HOIST DOWN L/O LED
MAIN HOIST DOWN UNLOCK SOL
AUX HOIST DOWN L/O LED
AUX HOIST DOWN UNLOCK SOL
DI E1 (+24V=HOUSE PIN ENGAGED)
DI E1 GND
DI E4 (+24V=AREA DEF)
DI E4 GND
DI E5 (+24V=CM RET)
DI E5 GND
+24V
GND
AGND
DI 1 GND
DI 2 GND
DI 3 GND
DI 4 GND
DI 5 GND
DI 6 GND
+24V
GND
LMI UNLOCK SOLS
TELE EXTEND PRESSURE SW
TELE RETRACT PRESSURE SW
HIGH=AUTO MODE/NONE=MANUAL MODE
OM/FLY TELE
CM TELE
IM TELE
MAIN HOIST DOWN UNLOCK SOL
AUX HOIST DOWN UNLOCK SOL
MAIN/AUX HOIST DOWN L/O LED
TELE OUT OF SEQUENCE
LMI L/O ALARM
HOUSE LOCK PIN SWITCH
TELE PROP ANALOG GND
TELE ROD DRAIN SOL
TELE EXTEND PROP SOL
TELE RETRACT PROP SOL
7 IF MAIN HOIST 3rd WRAP LIMIT KIT IS NOT REQ'D, INSTALL JUMPER WIRE FROM RELAY SOCKET K101 TERMINAL #12 TO #13
9 WIRE TO NORMALLY OPEN CONTACTS OF SWITCH, WHICH ARE HELD CLOSED BY A CAM UNDER NORMAL OPERATION
10 IF MAIN HOIST 3rd WRAP LIMIT KIT IS INSTALLED, JUMPER MUST BE REMOVED
11 IF AUX HOIST 3rd WRAP LIMIT KIT IS INSTALLED, JUMPER MUST BE REMOVED

Drawing 12.3

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

11.2 Wiring Schematic - RT 865 BXL

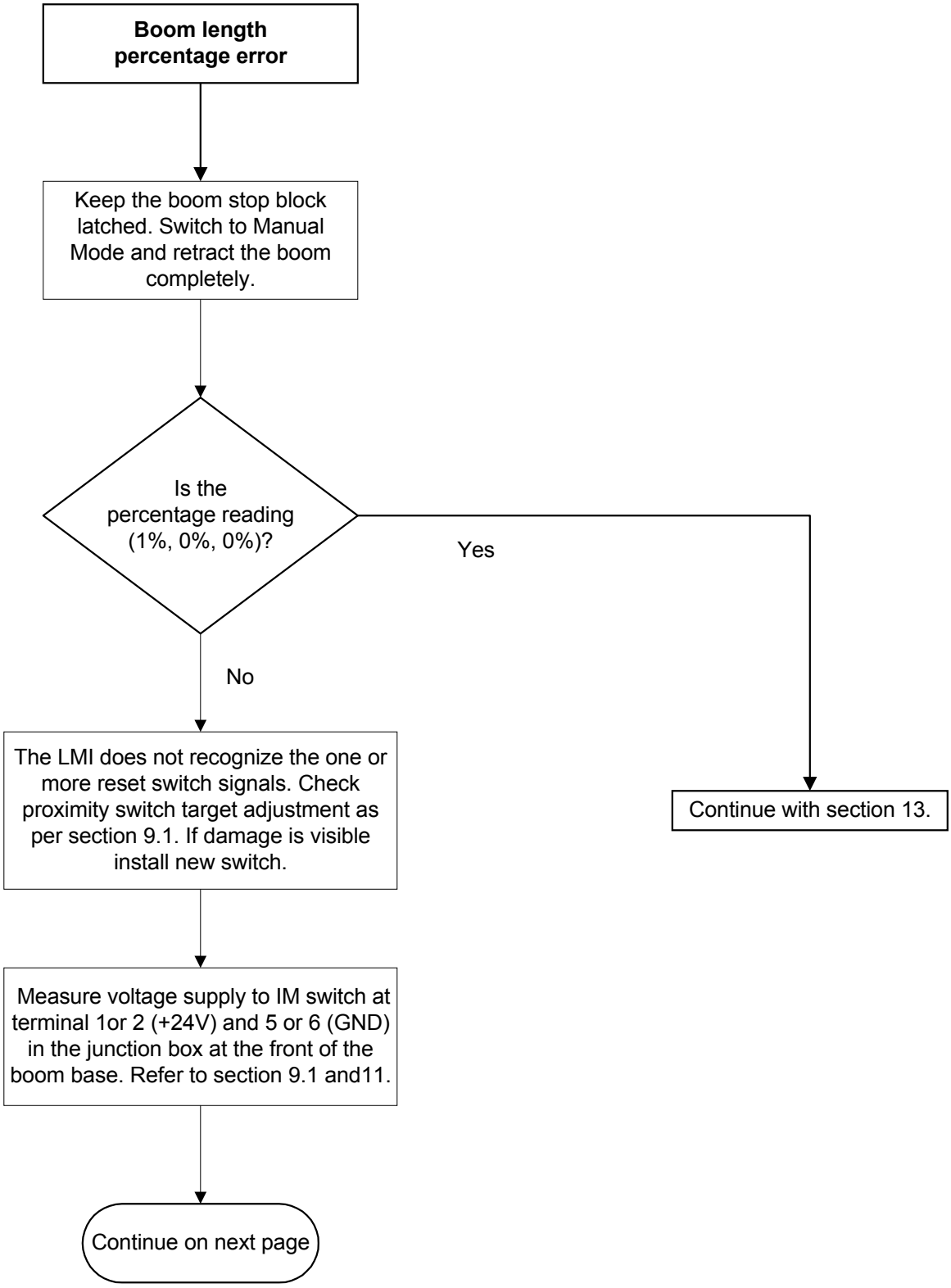
Optional Data Logger Connection



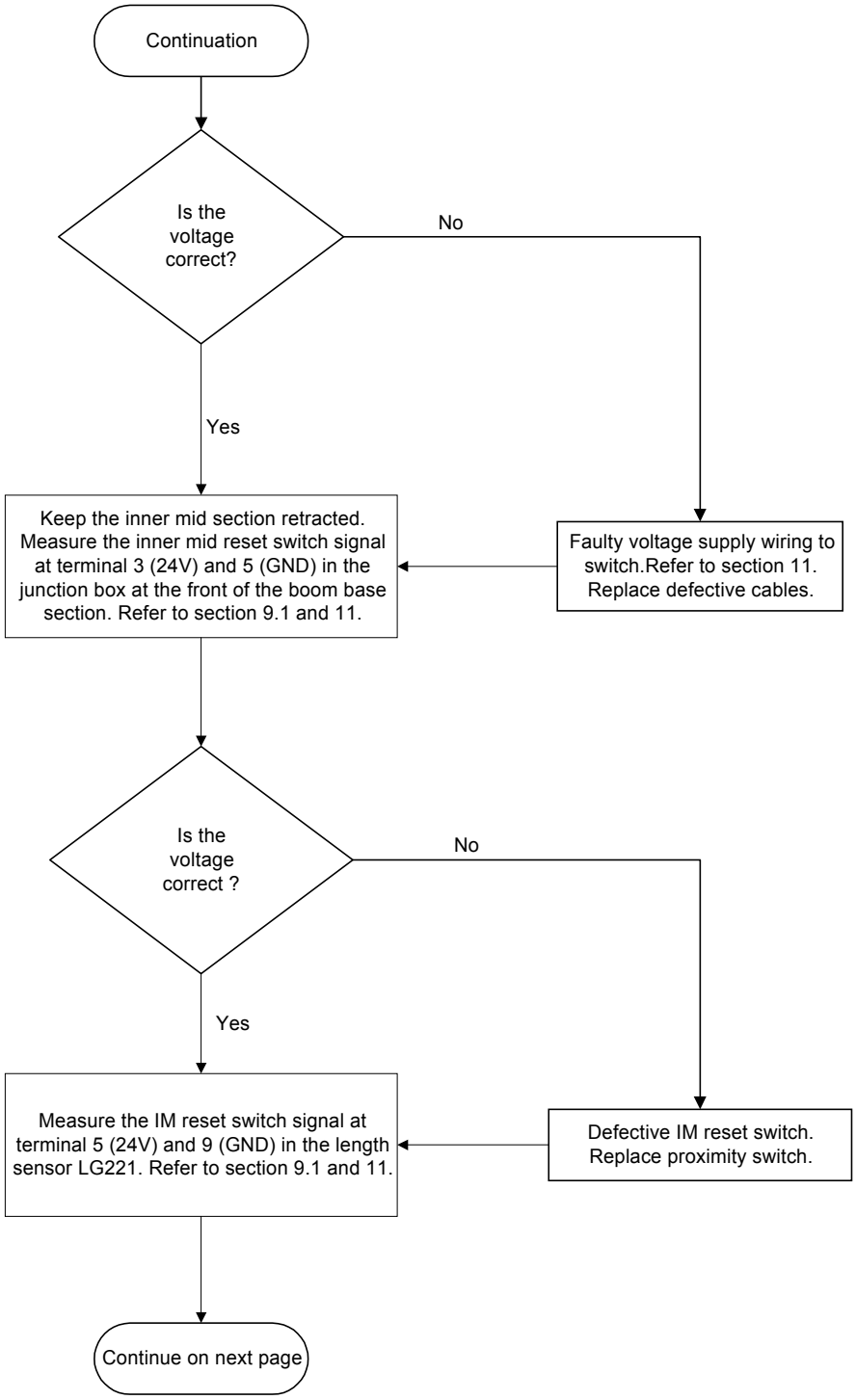
Drawing 12.4

PAT Equipment Corporation reserves proprietary rights to this drawing and to the data shown there on. The drawing and data are confidential and are not to be used or reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.

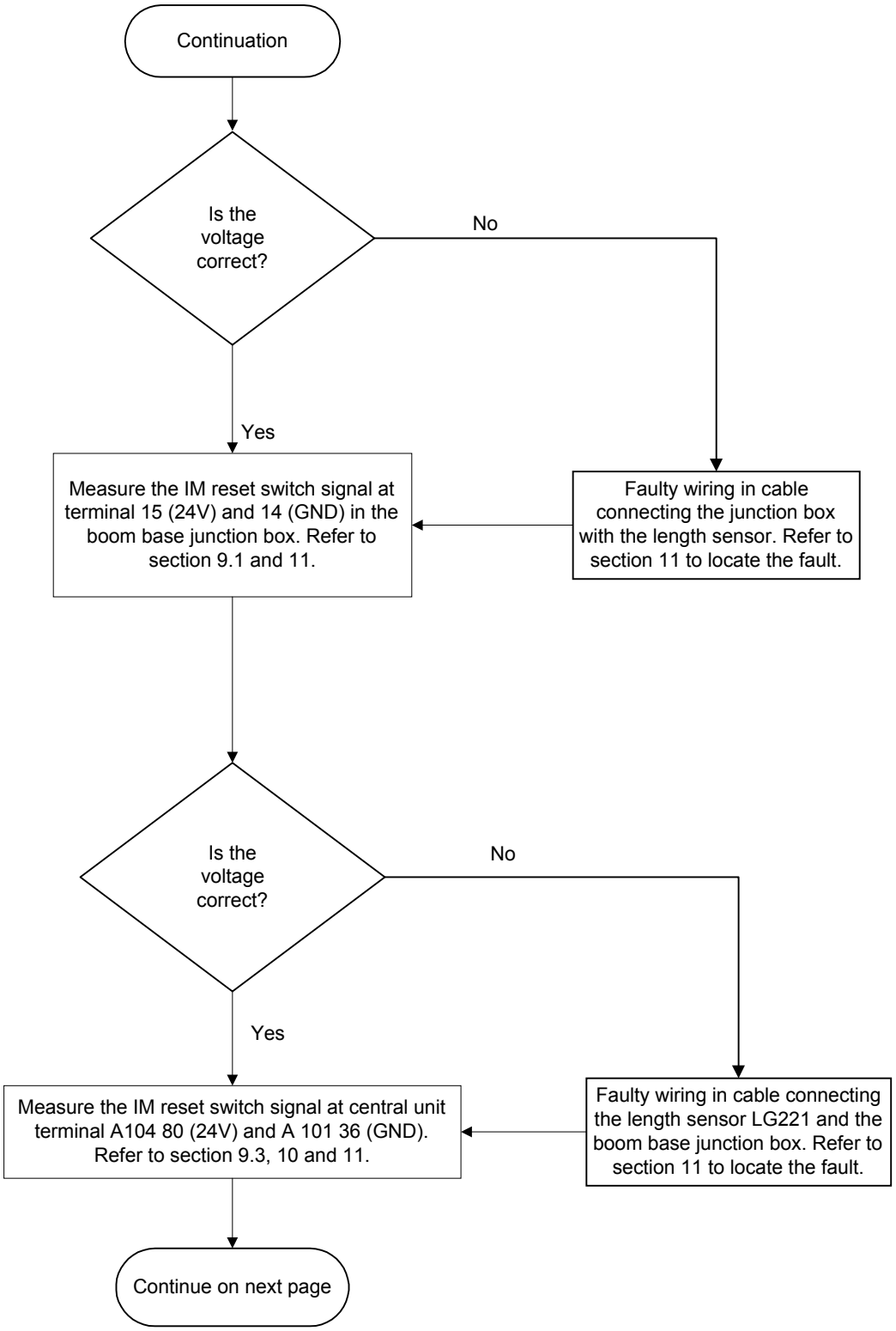
12. Boom Length Percentage Error


Boom length percentage error
Keep the boom stop block latched. Switch to Manual Mode and retract the boom completely.
Is the percentage reading (1%, 0%, 0%)?
Yes
No
Continue with section 13.
The LMI does not recognize the one or more reset switch signals. Check proximity switch target adjustment as per section 9.1. If damage is visible install new switch.
Measure voltage supply to IM switch at terminal 1or 2 (+24V) and 5 or 6 (GND) in the junction box at the front of the boom base. Refer to section 9.1 and11.
Continue on next page

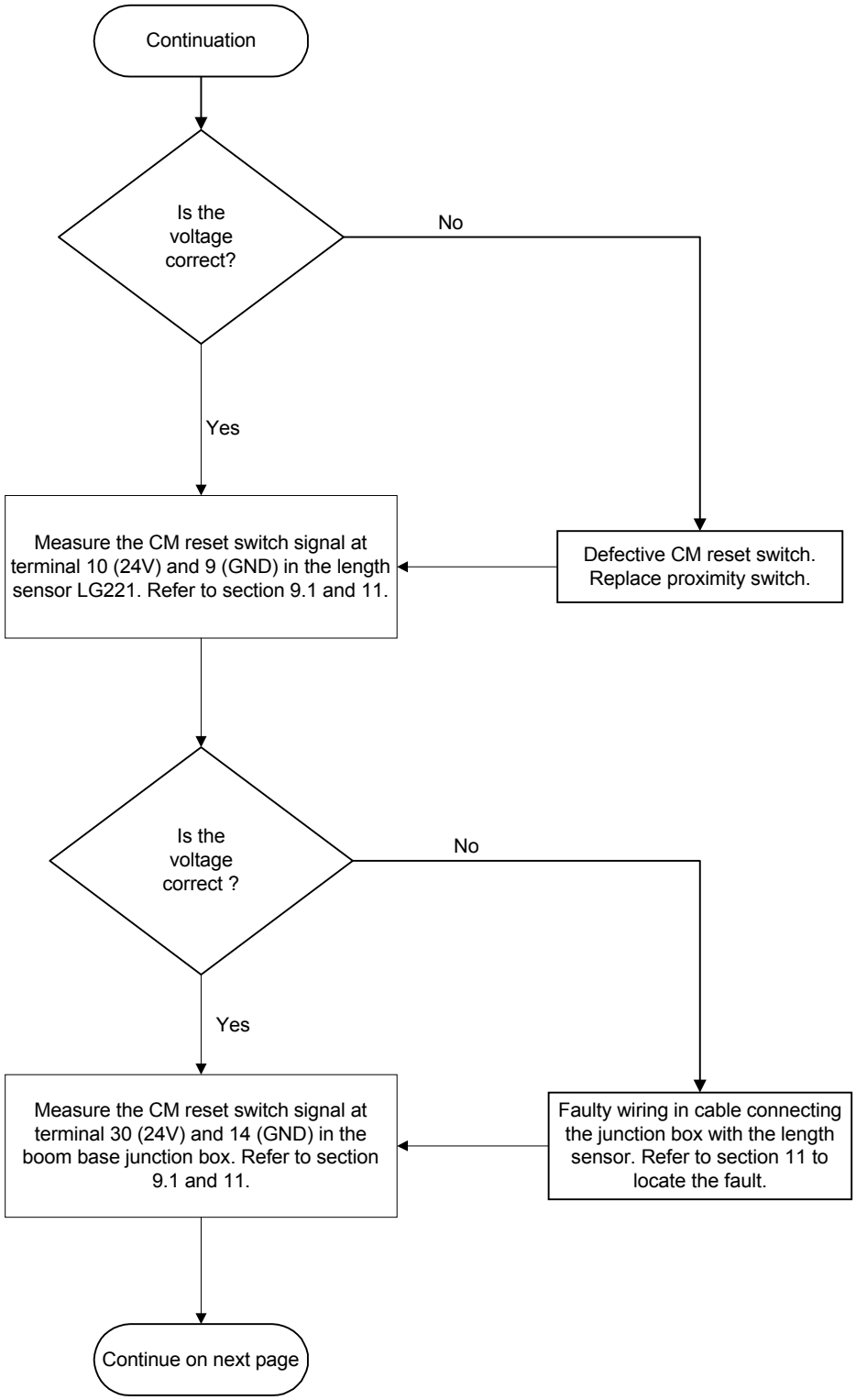
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Keep the inner mid section retracted. Measure the inner mid reset switch signal at terminal 3 (24V) and 5 (GND) in the junction box at the front of the boom base section. Refer to section 9.1 and 11.
Faulty voltage supply wiring to switch.Refer to section 11. Replace defective cables.
Is the voltage correct ?
No
Yes
Measure the IM reset switch signal at terminal 5 (24V) and 9 (GND) in the length sensor LG221. Refer to section 9.1 and 11.
Defective IM reset switch. Replace proximity switch.
Continue on next page

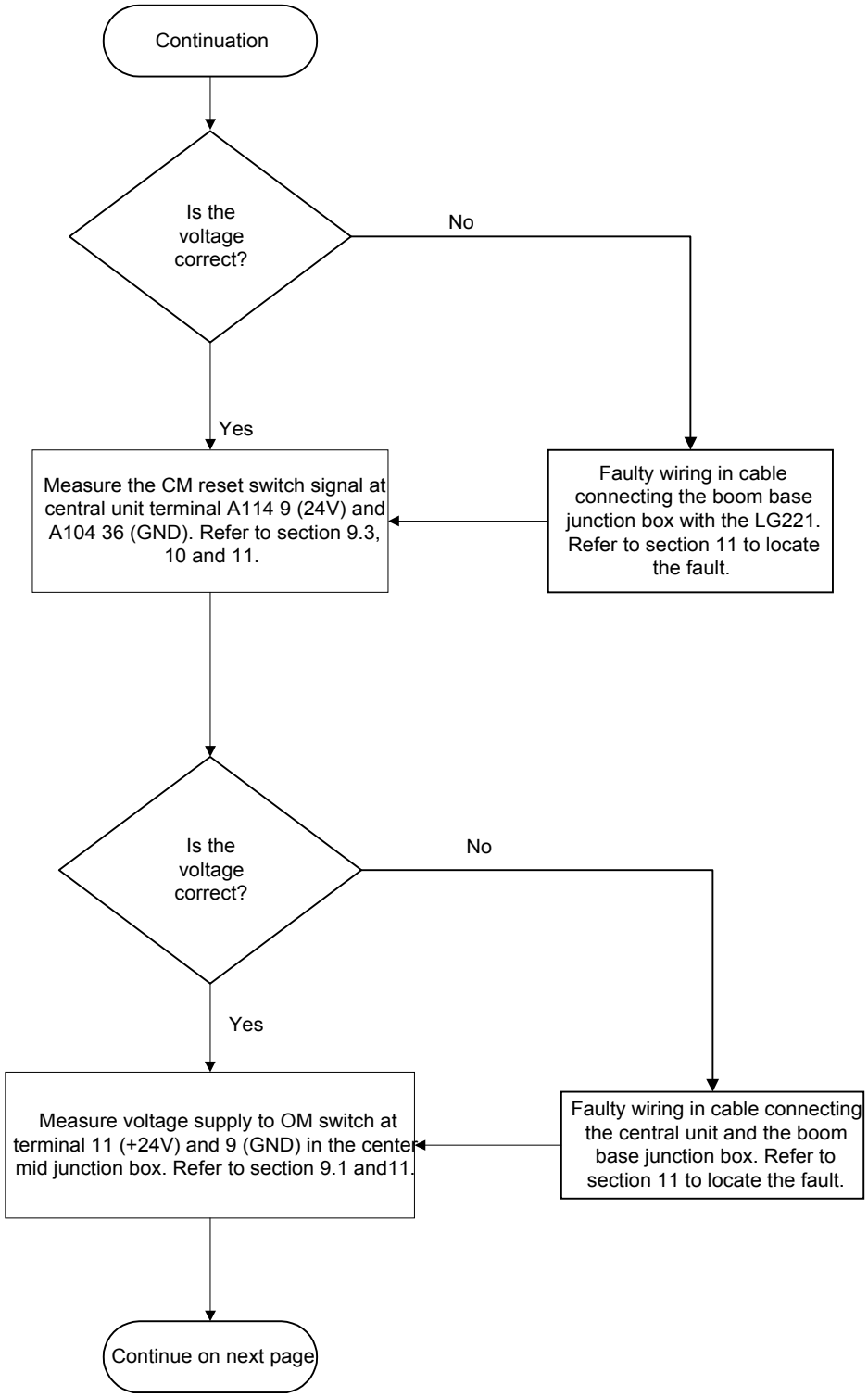
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure the IM reset switch signal at terminal 15 (24V) and 14 (GND) in the boom base junction box. Refer to section 9.1 and 11.
Faulty wiring in cable connecting the junction box with the length sensor. Refer to section 11 to locate the fault.
Is the voltage correct?
No
Yes
Measure the IM reset switch signal at central unit terminal A104 80 (24V) and A 101 36 (GND). Refer to section 9.3, 10 and 11.
Faulty wiring in cable connecting the length sensor LG221 and the boom base junction box. Refer to section 11 to locate the fault.
Continue on next page

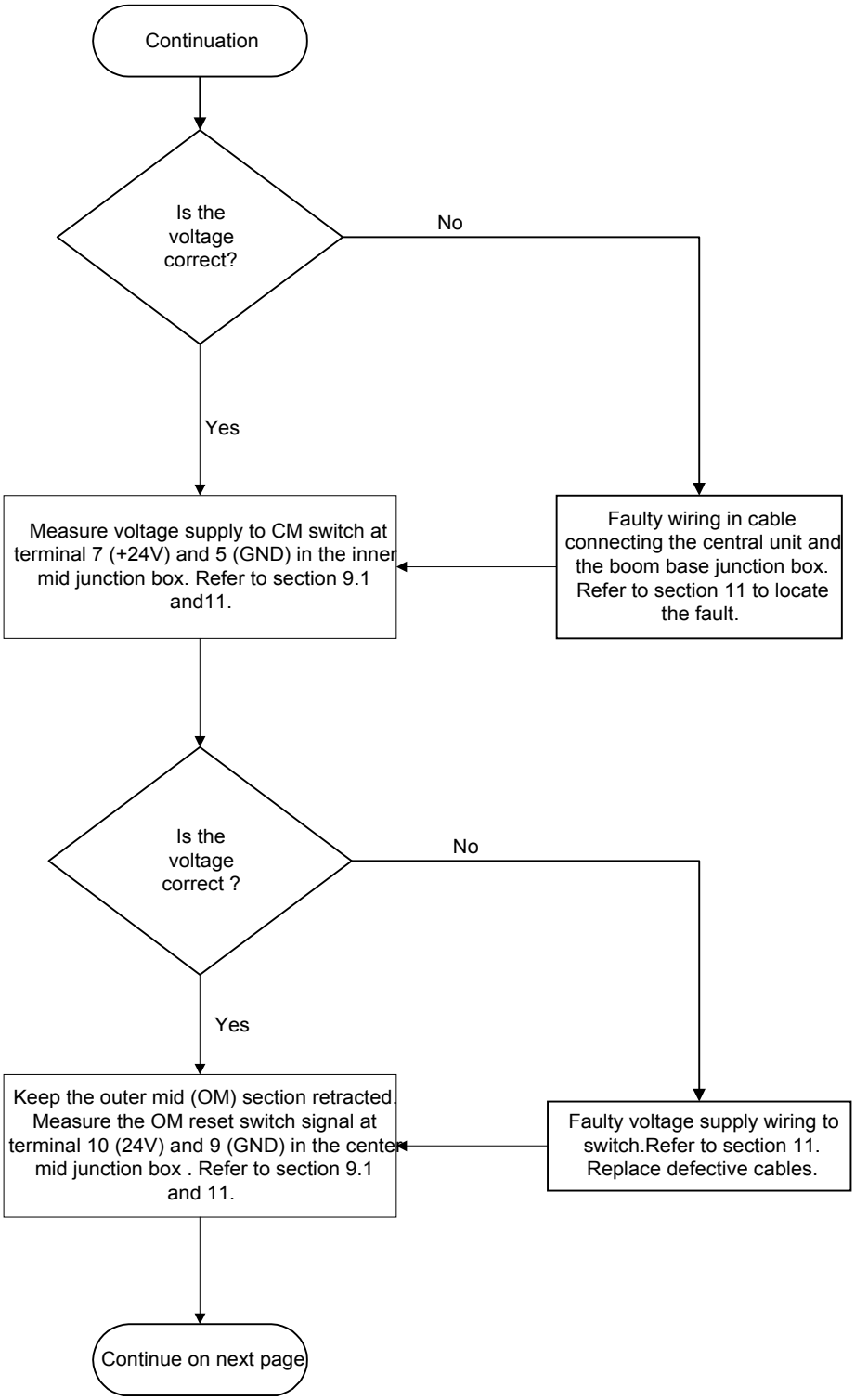
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure the CM reset switch signal at terminal 10 (24V) and 9 (GND) in the length sensor LG221. Refer to section 9.1 and 11.
Defective CM reset switch. Replace proximity switch.
Is the voltage correct ?
No
Yes
Measure the CM reset switch signal at terminal 30 (24V) and 14 (GND) in the boom base junction box. Refer to section 9.1 and 11.
Faulty wiring in cable connecting the junction box with the length sensor. Refer to section 11 to locate the fault.
Continue on next page

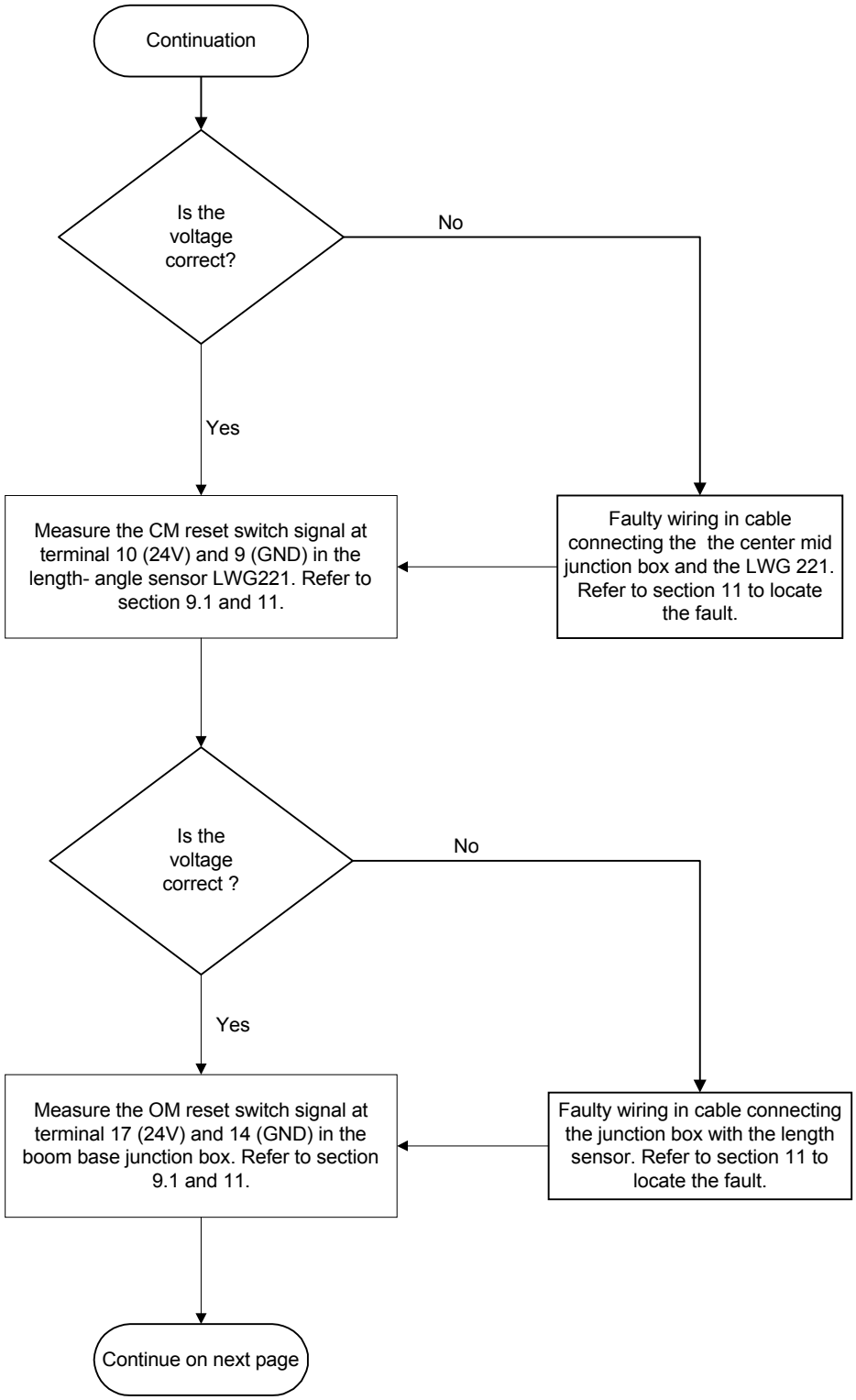
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure the CM reset switch signal at central unit terminal A114 9 (24V) and A104 36 (GND). Refer to section 9.3, 10 and 11.
Faulty wiring in cable connecting the boom base junction box with the LG221. Refer to section 11 to locate the fault.
Is the voltage correct?
No
Yes
Measure voltage supply to OM switch at terminal 11 (+24V) and 9 (GND) in the center mid junction box. Refer to section 9.1 and11.
Faulty wiring in cable connecting the central unit and the boom base junction box. Refer to section 11 to locate the fault.
Continue on next page

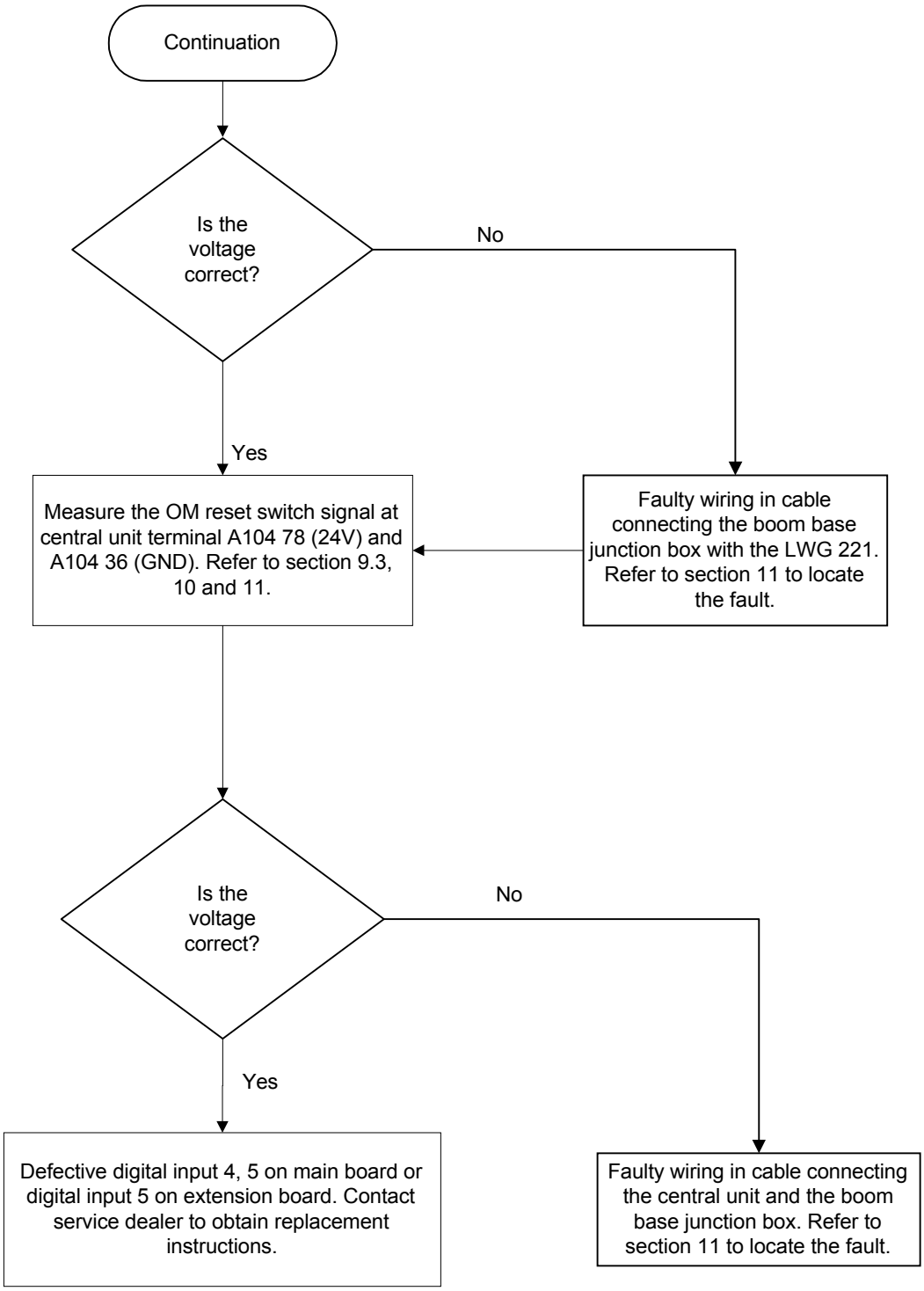
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure voltage supply to CM switch at terminal 7 (+24V) and 5 (GND) in the inner mid junction box. Refer to section 9.1 and11.
Faulty wiring in cable connecting the central unit and the boom base junction box. Refer to section 11 to locate the fault.
Is the voltage correct ?
No
Yes
Keep the outer mid (OM) section retracted. Measure the OM reset switch signal at terminal 10 (24V) and 9 (GND) in the center mid junction box . Refer to section 9.1 and 11.
Faulty voltage supply wiring to switch.Refer to section 11. Replace defective cables.
Continue on next page

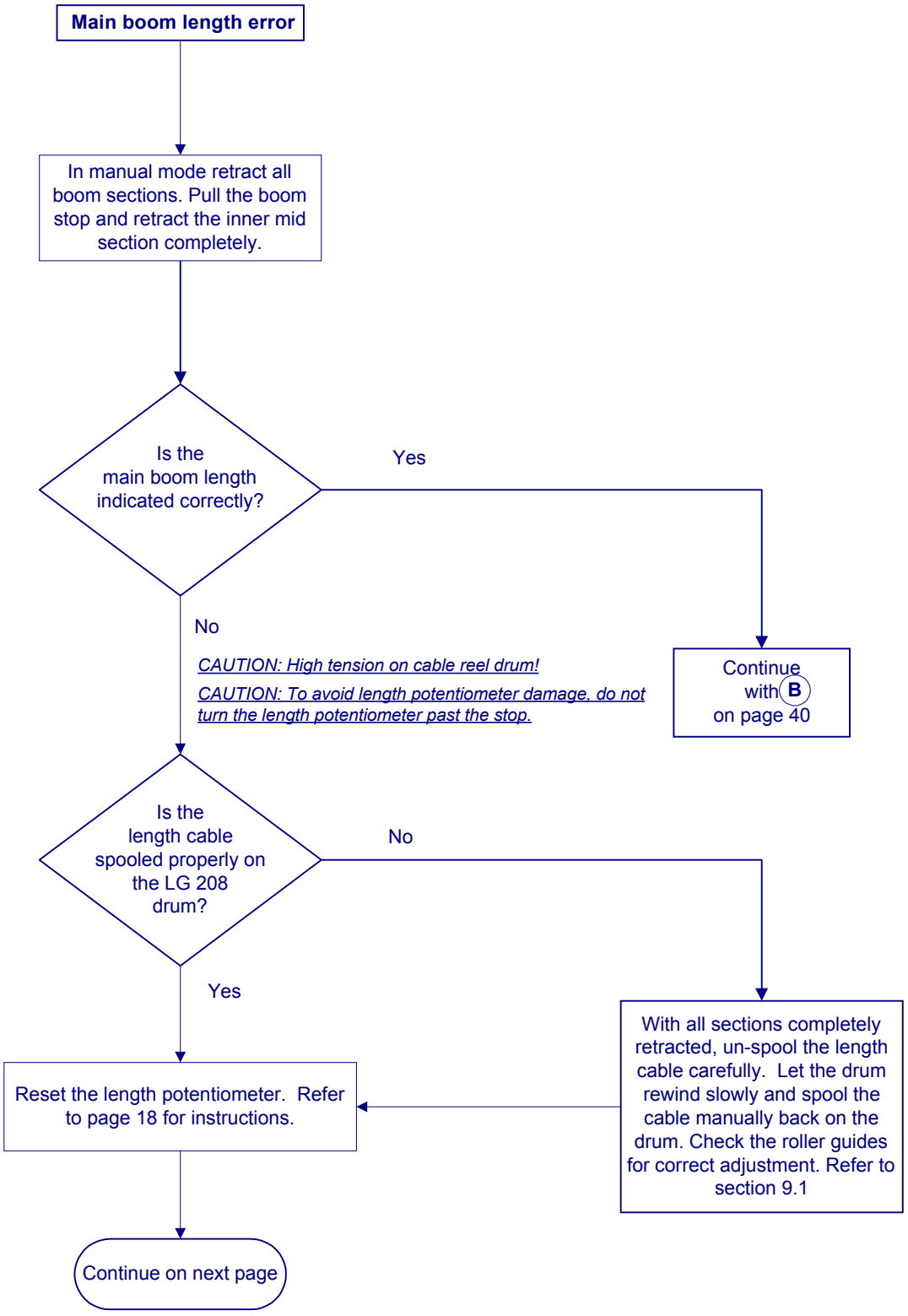
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure the CM reset switch signal at terminal 10 (24V) and 9 (GND) in the length- angle sensor LWG221. Refer to section 9.1 and 11.
Faulty wiring in cable connecting the the center mid junction box and the LWG 221. Refer to section 11 to locate the fault.
Is the voltage correct ?
No
Yes
Measure the OM reset switch signal at terminal 17 (24V) and 14 (GND) in the boom base junction box. Refer to section 9.1 and 11.
Faulty wiring in cable connecting the junction box with the length sensor. Refer to section 11 to locate the fault.
Continue on next page

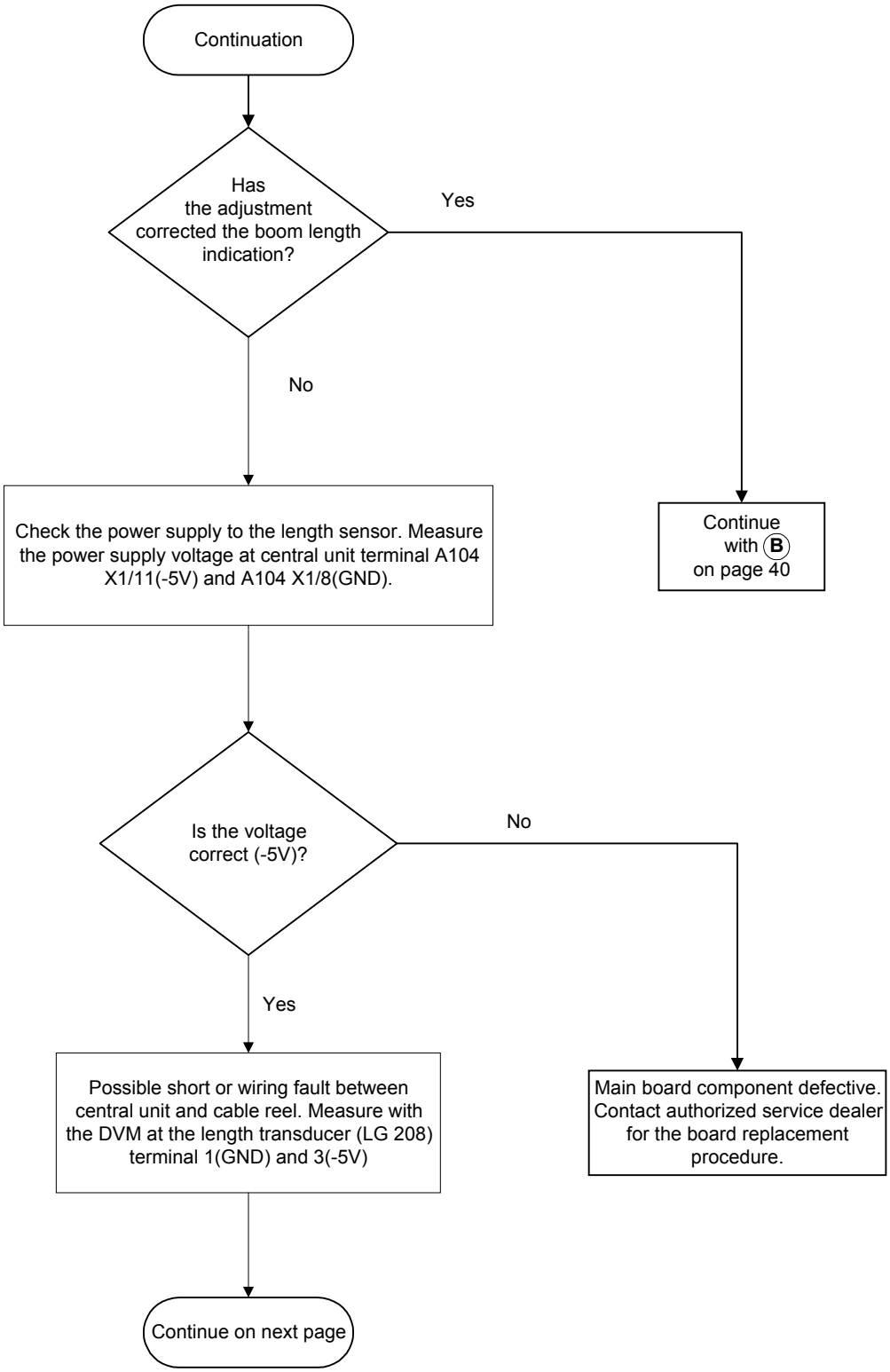
12. Continuation


Continuation
Is the voltage correct?
No
Yes
Measure the OM reset switch signal at central unit terminal A104 78 (24V) and A104 36 (GND). Refer to section 9.3, 10 and 11.
Faulty wiring in cable connecting the boom base junction box with the LWG 221. Refer to section 11 to locate the fault.
Is the voltage correct?
No
Yes
Defective digital input 4, 5 on main board or digital input 5 on extension board. Contact service dealer to obtain replacement instructions.
Faulty wiring in cable connecting the central unit and the boom base junction box. Refer to section 11 to locate the fault.

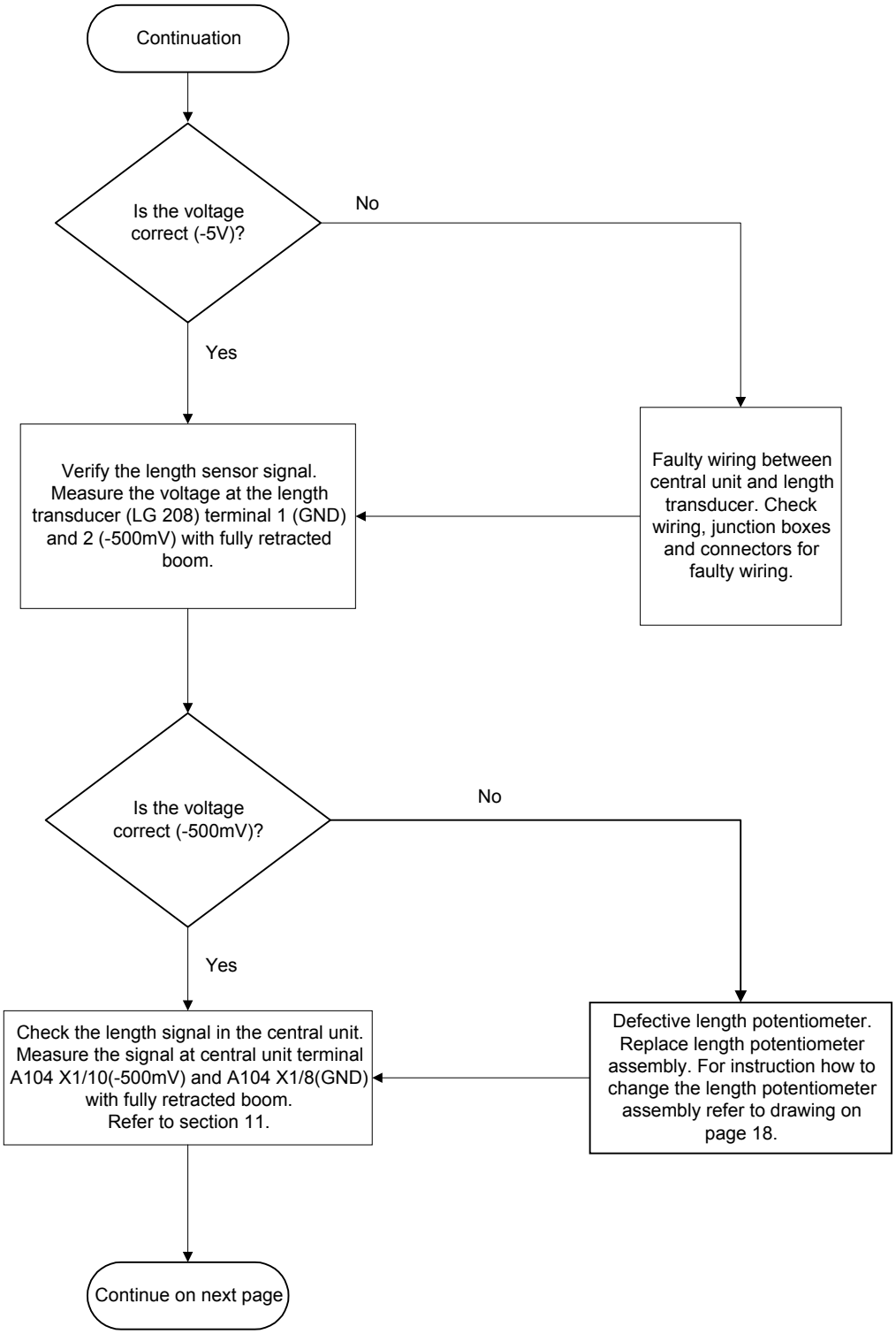
13. Main Boom Length Error


Main boom length error
In manual mode retract all boom sections. Pull the boom stop and retract the inner mid section completely.
Is the main boom length indicated correctly?
Yes
No
CAUTION: High tension on cable reel drum!
CAUTION: To avoid length potentiometer damage, do not turn the length potentiometer past the stop.
Continue with B on page 40
Is the length cable spooled properly on the LG 208 drum?
No
Yes
With all sections completely retracted, un-spool the length cable carefully. Let the drum rewind slowly and spool the cable manually back on the drum. Check the roller guides for correct adjustment. Refer to section 9.1
Reset the length potentiometer. Refer to page 18 for instructions.
Continue on next page

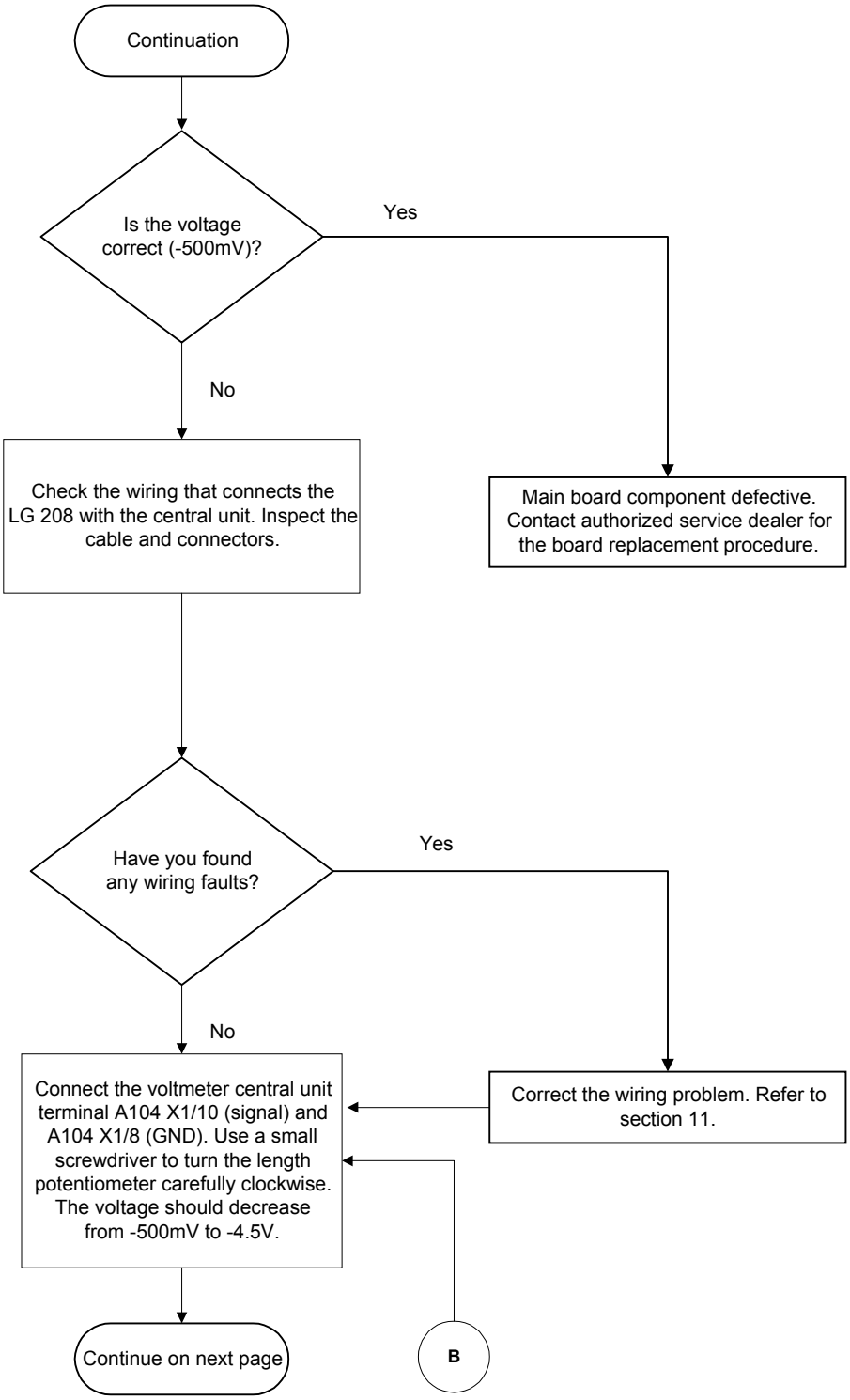
13. Continuation


Continuation
Has the adjustment corrected the boom length indication?
Yes
No
Check the power supply to the length sensor. Measure the power supply voltage at central unit terminal A104 X1/11(-5V) and A104 X1/8(GND).
Continue with (B) on page 40
Is the voltage correct (-5V)?
No
Yes
Possible short or wiring fault between central unit and cable reel. Measure with the DVM at the length transducer (LG 208) terminal 1(GND) and 3(-5V)
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Continue on next page

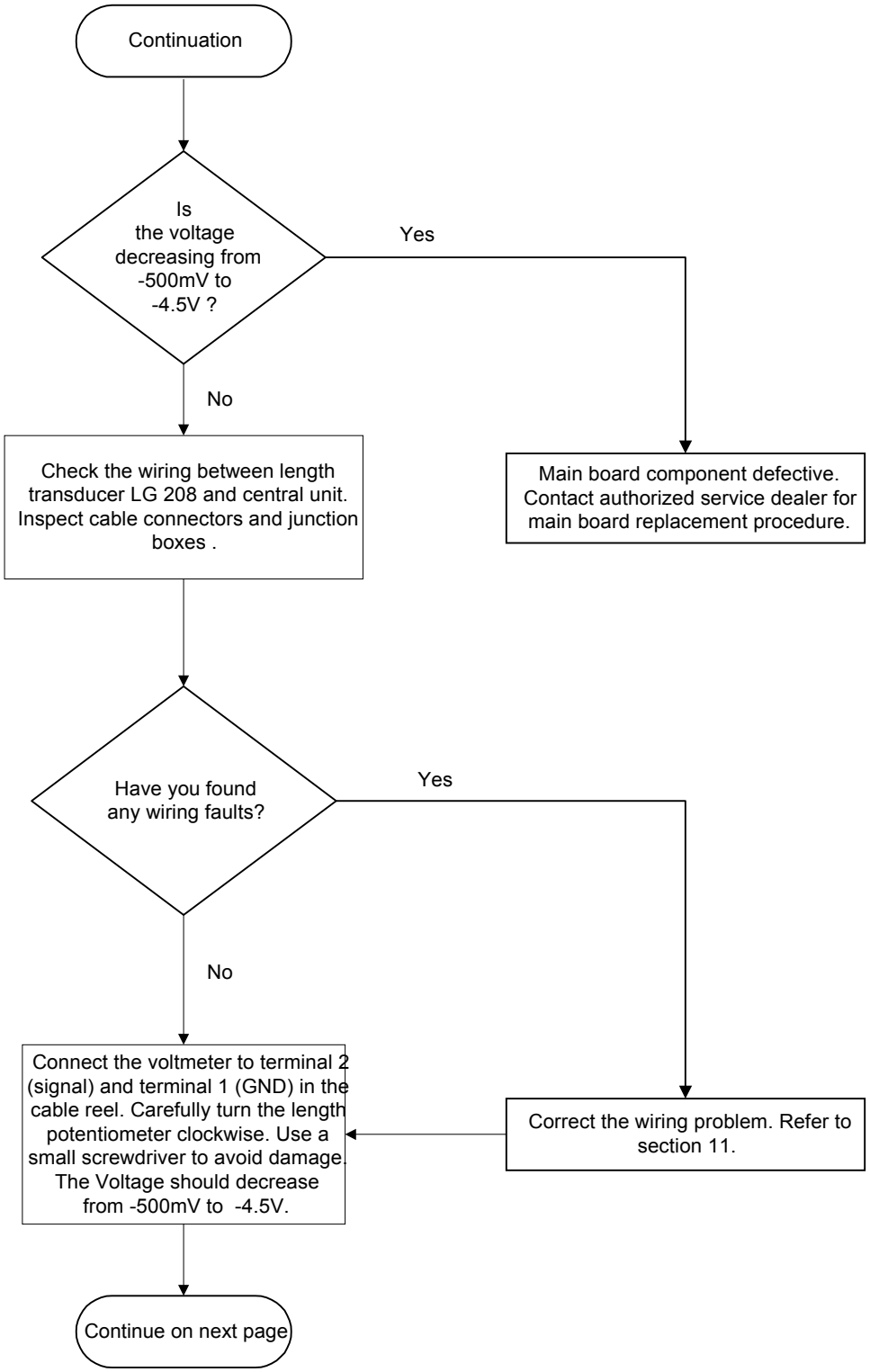
13. Continuation


Continuation
Is the voltage correct (-5V)?
No
Yes
Verify the length sensor signal. Measure the voltage at the length transducer (LG 208) terminal 1 (GND) and 2 (-500mV) with fully retracted boom.
Faulty wiring between central unit and length transducer. Check wiring, junction boxes and connectors for faulty wiring.
Is the voltage correct (-500mV)?
No
Yes
Check the length signal in the central unit. Measure the signal at central unit terminal A104 X1/10(-500mV) and A104 X1/8(GND) with fully retracted boom. Refer to section 11.
Defective length potentiometer. Replace length potentiometer assembly. For instruction how to change the length potentiometer assembly refer to drawing on page 18.
Continue on next page

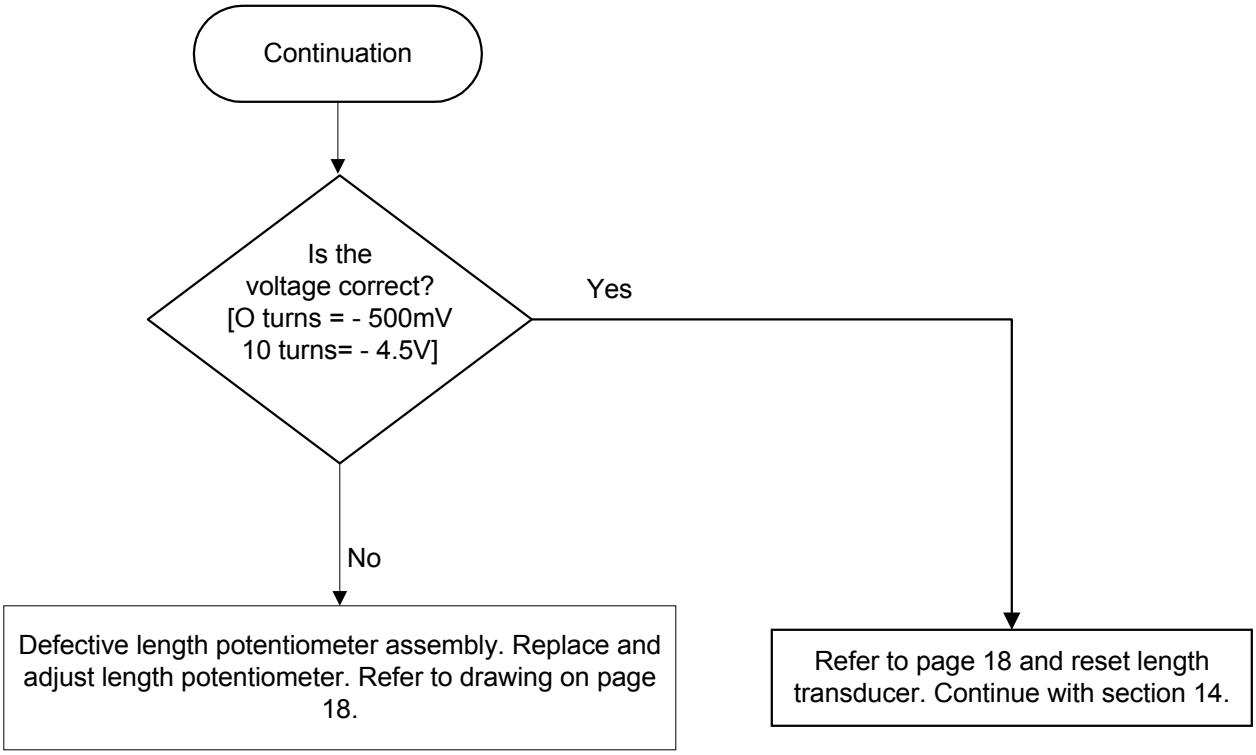
13. Continuation


Continuation
Is the voltage correct (-500mV)?
Yes
No
Check the wiring that connects the LG 208 with the central unit. Inspect the cable and connectors.
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Have you found any wiring faults?
Yes
No
Connect the voltmeter central unit terminal A104 X1/10 (signal) and A104 X1/8 (GND). Use a small screwdriver to turn the length potentiometer carefully clockwise. The voltage should decrease from -500mV to -4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page
B

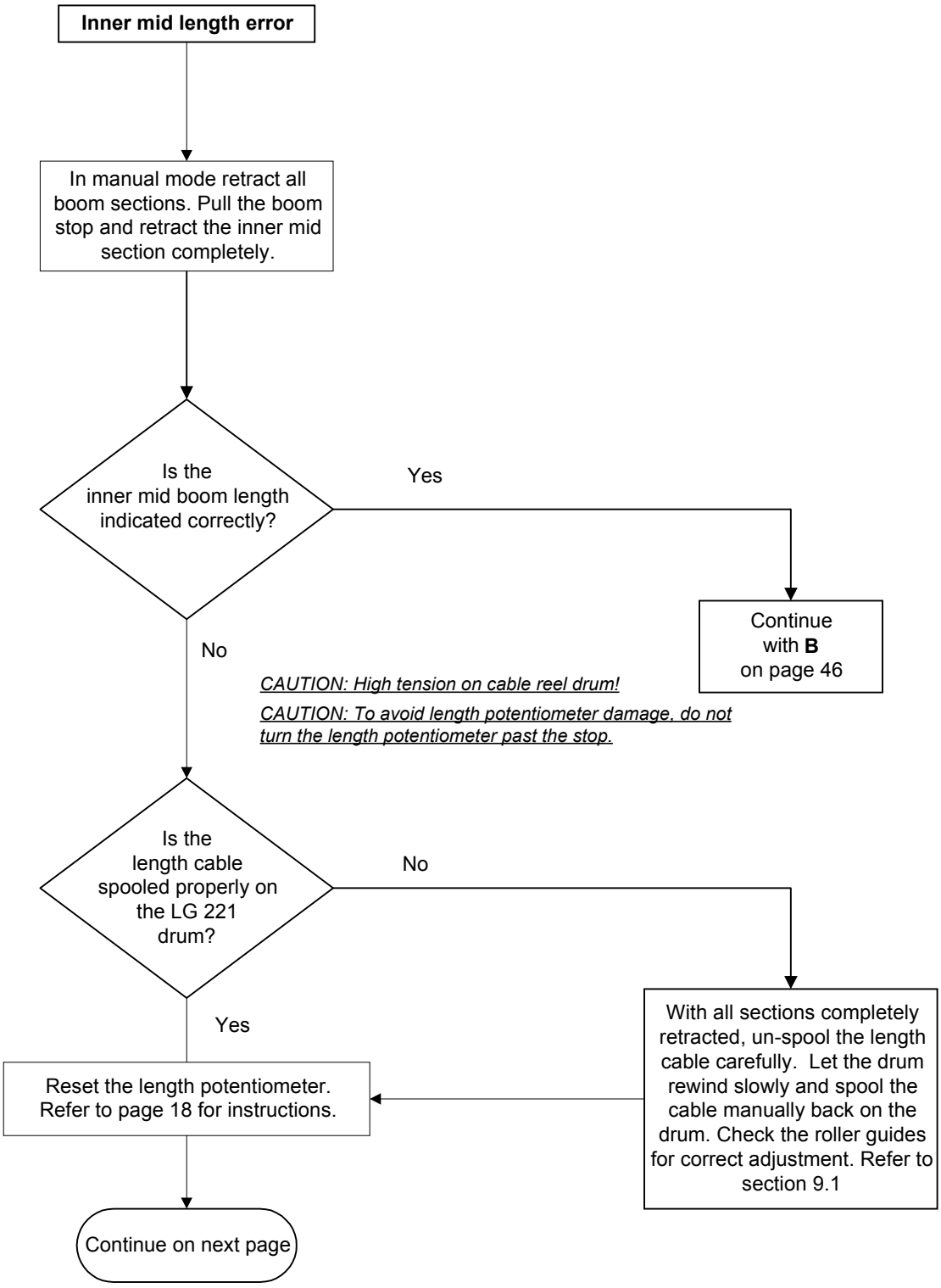
13. Continuation


Continuation
Is the voltage decreasing from -500mV to -4.5V ?
Yes
No
Check the wiring between length transducer LG 208 and central unit. Inspect cable connectors and junction boxes .
Main board component defective. Contact authorized service dealer for main board replacement procedure.
Have you found any wiring faults?
Yes
No
Connect the voltmeter to terminal 2 (signal) and terminal 1 (GND) in the cable reel. Carefully turn the length potentiometer clockwise. Use a small screwdriver to avoid damage. The Voltage should decrease from -500mV to -4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page

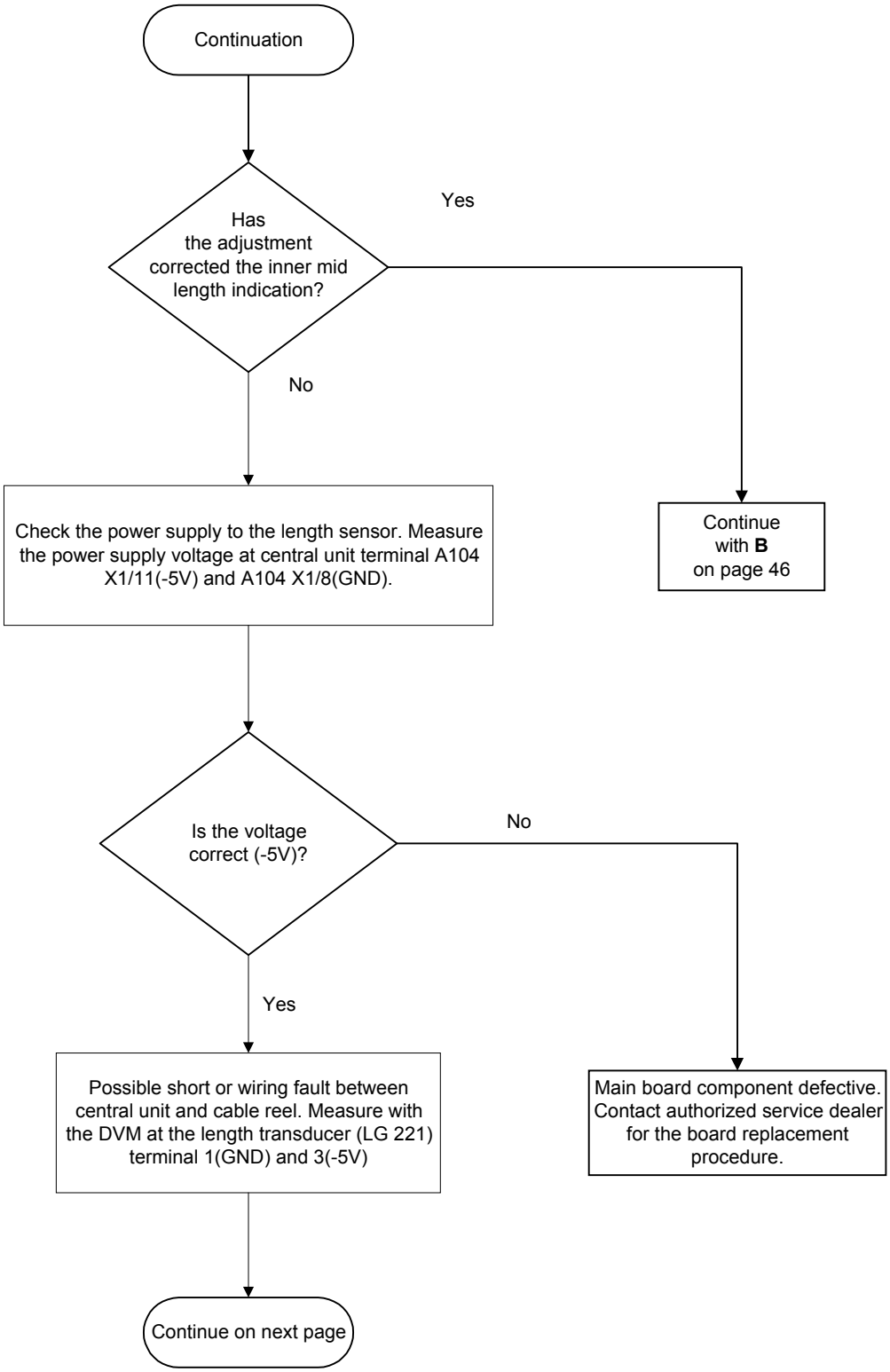
13. Continuation


Continuation
Is the voltage correct? [O turns = - 500mV 10 turns= - 4.5V]
Yes
No
Defective length potentiometer assembly. Replace and adjust length potentiometer. Refer to drawing on page 18.
Refer to page 18 and reset length transducer. Continue with section 14.

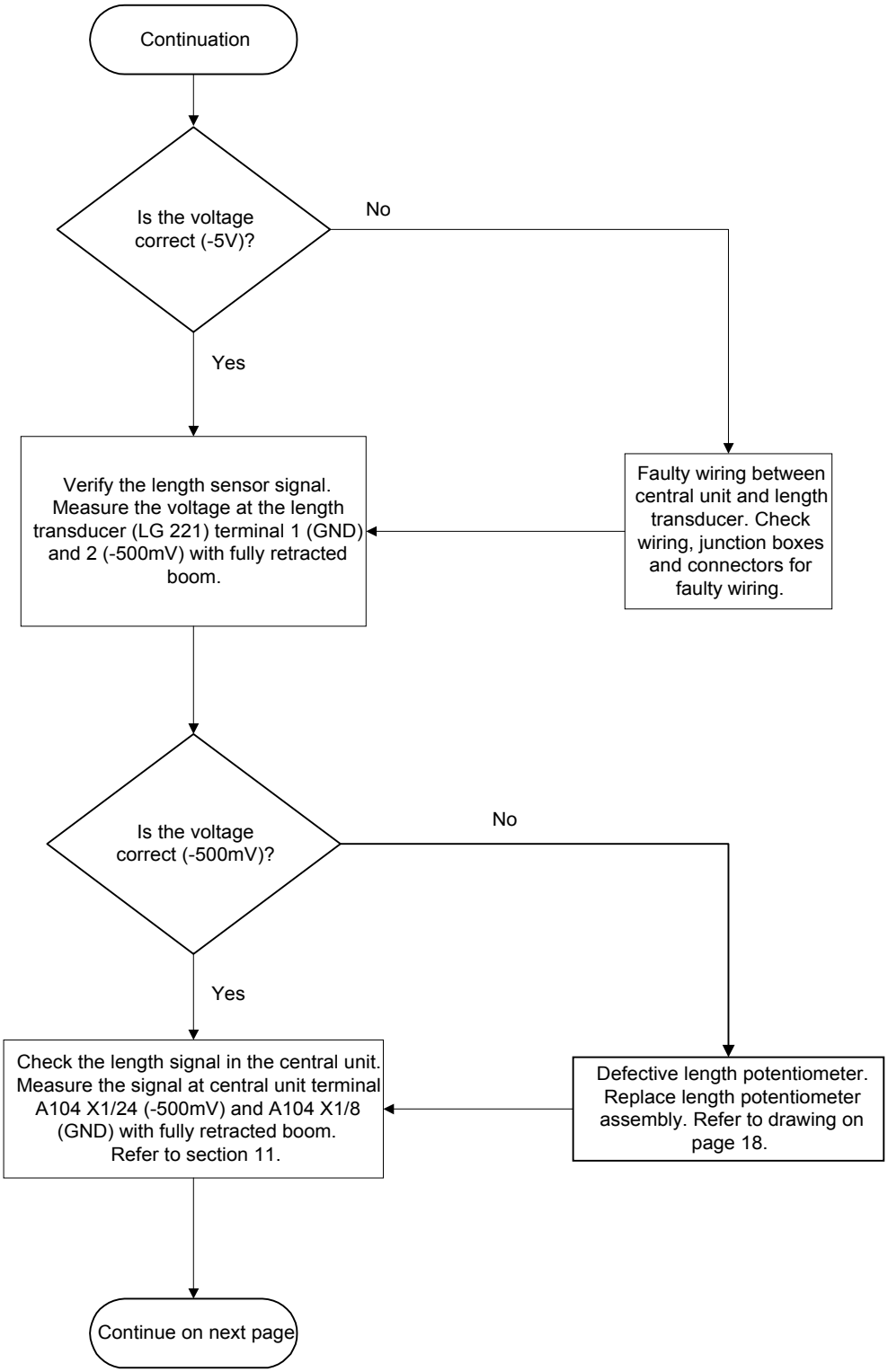
14. Inner Mid Length Error


Inner mid length error
In manual mode retract all boom sections. Pull the boom stop and retract the inner mid section completely.
Is the inner mid boom length indicated correctly?
Yes
Continue with **B** on page 46
No
CAUTION: High tension on cable reel drum!
CAUTION: To avoid length potentiometer damage, do not turn the length potentiometer past the stop.
Is the length cable spooled properly on the LG 221 drum?
No
With all sections completely retracted, un-spool the length cable carefully. Let the drum rewind slowly and spool the cable manually back on the drum. Check the roller guides for correct adjustment. Refer to section 9.1
Yes
Reset the length potentiometer. Refer to page 18 for instructions.
Continue on next page

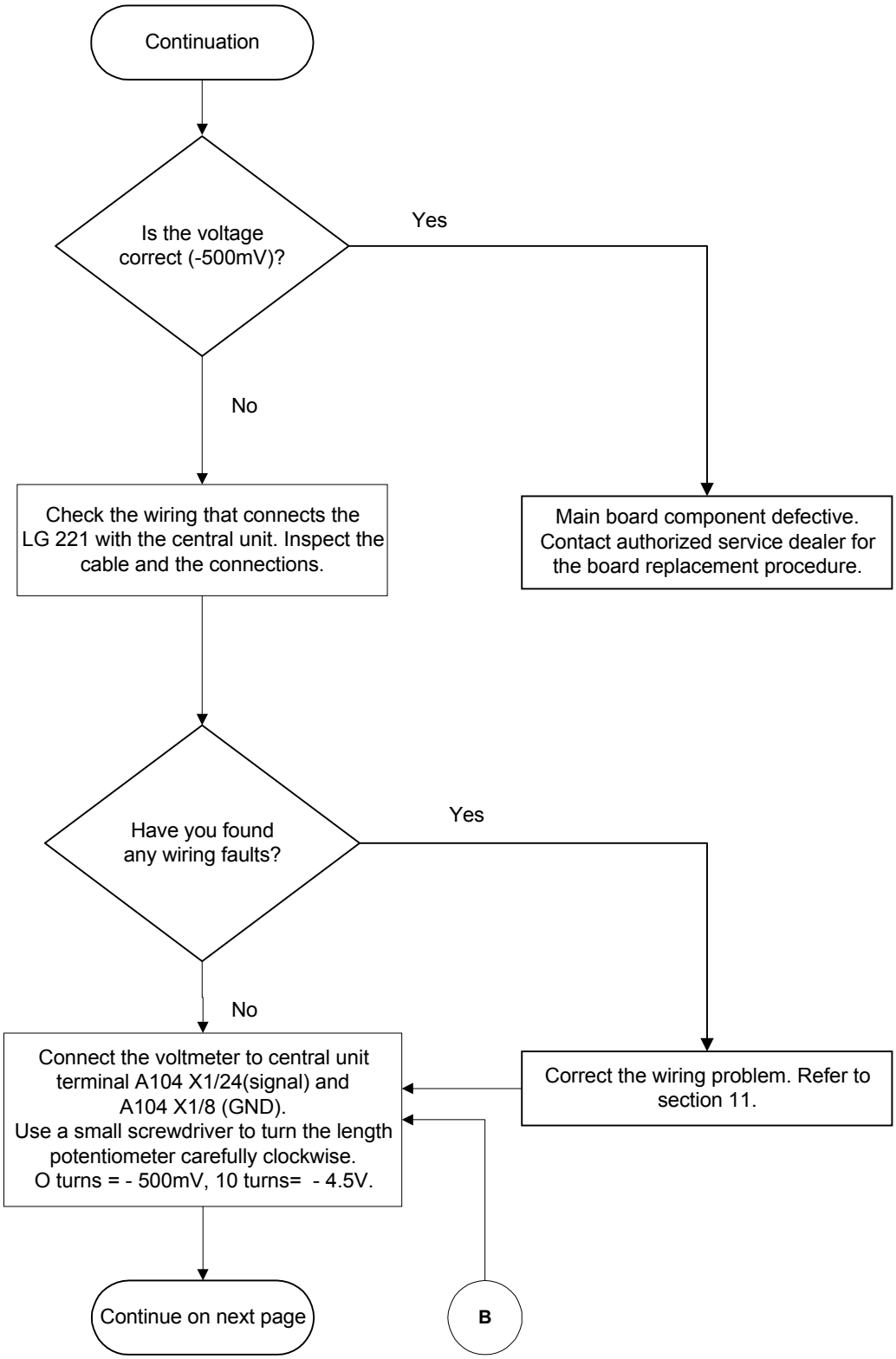
14. Continuation


Continuation
Has the adjustment corrected the inner mid length indication?
Yes
No
Continue with **B** on page 46
Check the power supply to the length sensor. Measure the power supply voltage at central unit terminal A104 X1/11(-5V) and A104 X1/8(GND).
Is the voltage correct (-5V)?
No
Yes
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Possible short or wiring fault between central unit and cable reel. Measure with the DVM at the length transducer (LG 221) terminal 1(GND) and 3(-5V)
Continue on next page

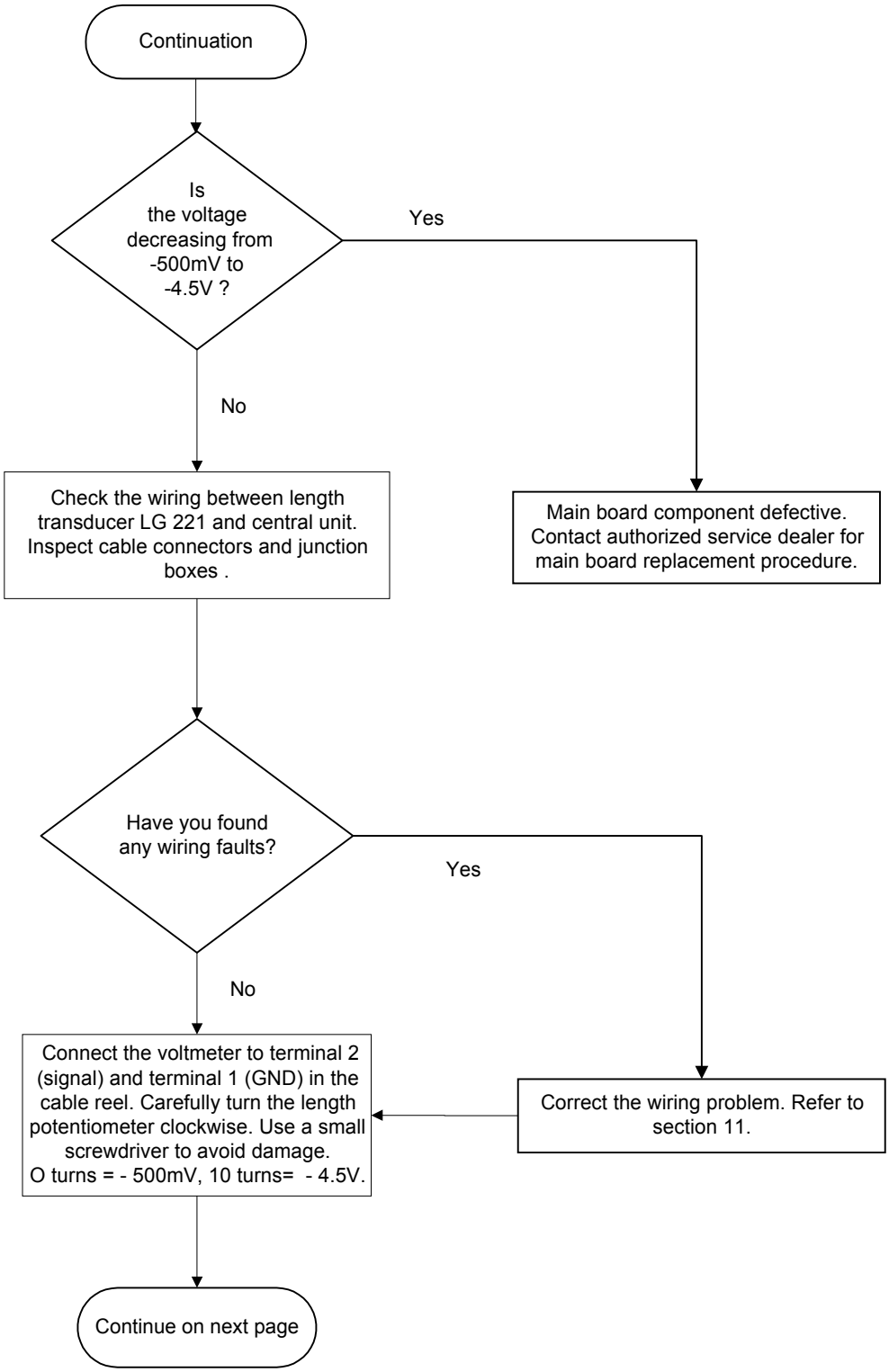
14. Continuation


Continuation
Is the voltage correct (-5V)?
No
Yes
Verify the length sensor signal. Measure the voltage at the length transducer (LG 221) terminal 1 (GND) and 2 (-500mV) with fully retracted boom.
Faulty wiring between central unit and length transducer. Check wiring, junction boxes and connectors for faulty wiring.
Is the voltage correct (-500mV)?
No
Yes
Check the length signal in the central unit. Measure the signal at central unit terminal A104 X1/24 (-500mV) and A104 X1/8 (GND) with fully retracted boom. Refer to section 11.
Defective length potentiometer. Replace length potentiometer assembly. Refer to drawing on page 18.
Continue on next page

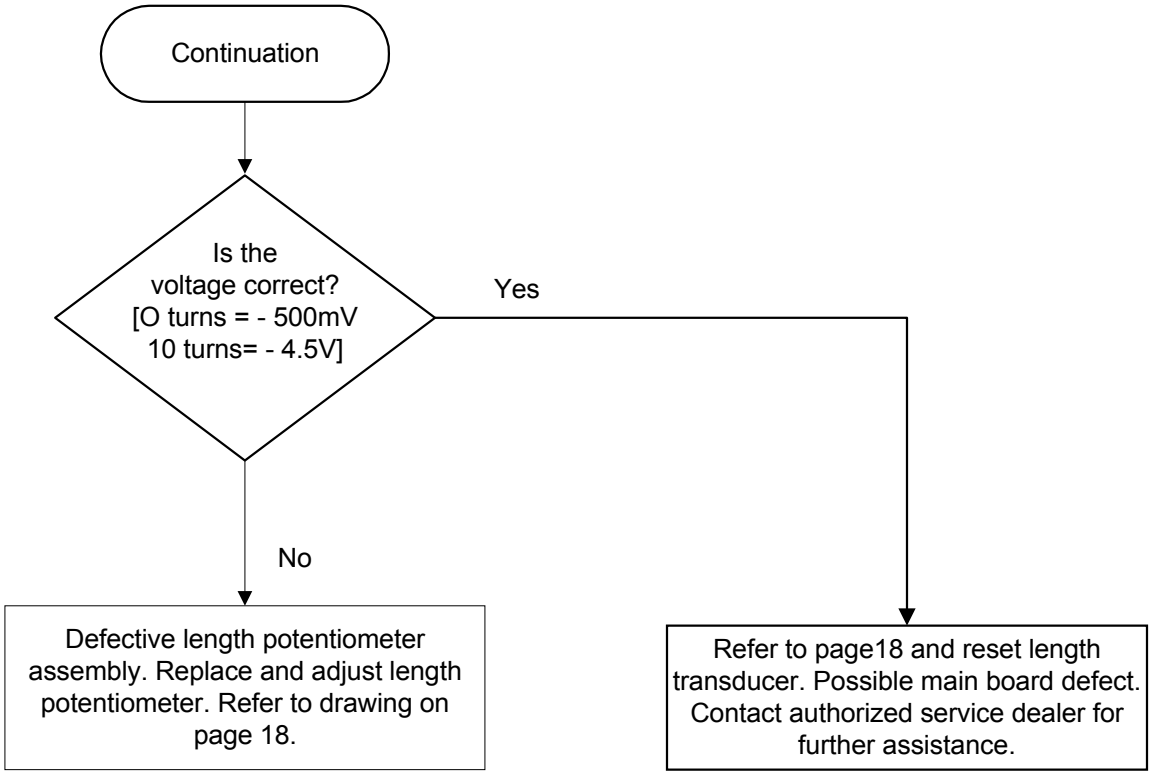
14. Continuation


Continuation
Is the voltage correct (-500mV)?
Yes
No
Check the wiring that connects the LG 221 with the central unit. Inspect the cable and the connections.
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Have you found any wiring faults?
Yes
No
Connect the voltmeter to central unit terminal A104 X1/24(signal) and A104 X1/8 (GND).
Use a small screwdriver to turn the length potentiometer carefully clockwise.
O turns = - 500mV, 10 turns= - 4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page
B

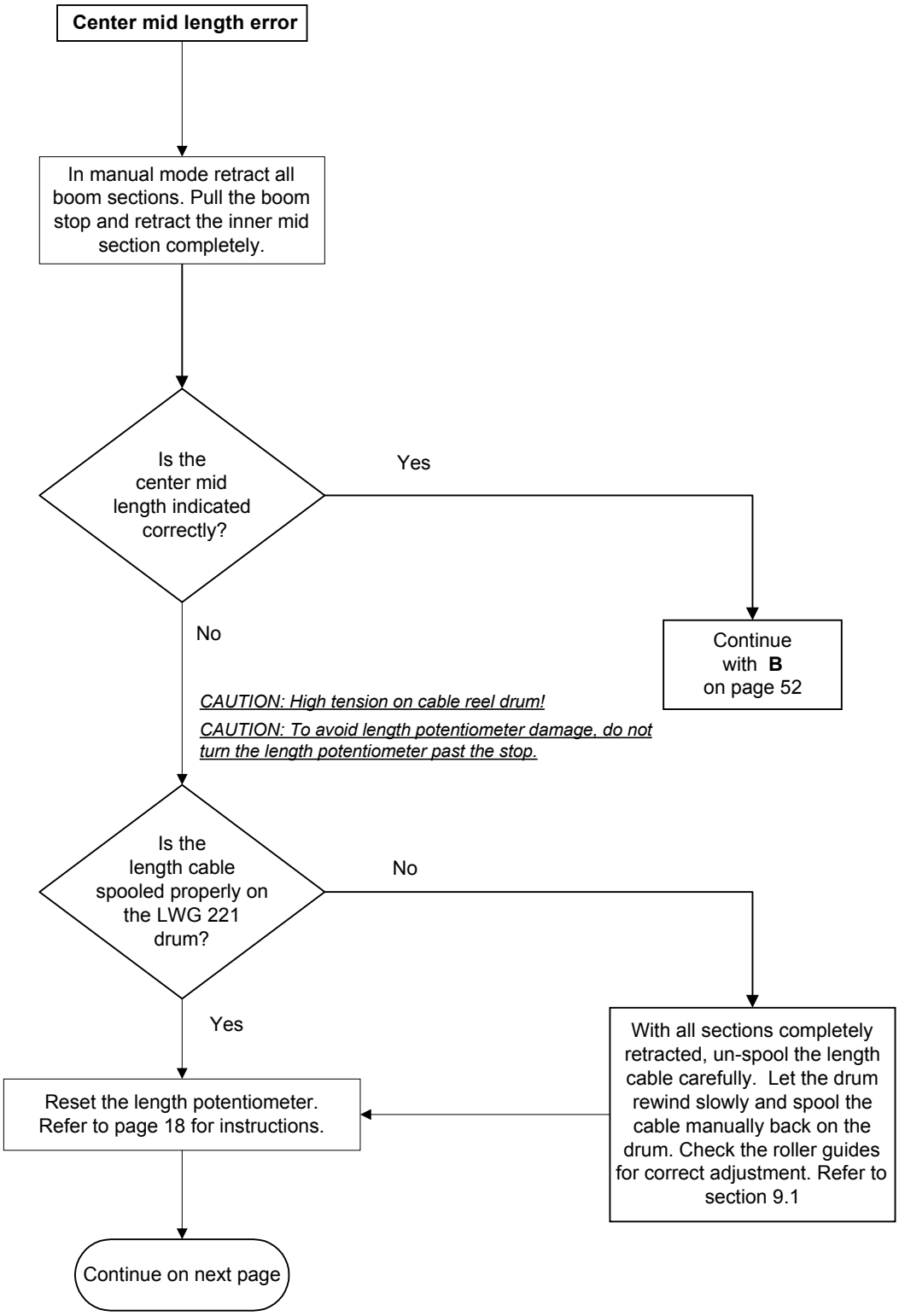
14. Continuation


Continuation
Is the voltage decreasing from -500mV to -4.5V ?
Yes
No
Check the wiring between length transducer LG 221 and central unit. Inspect cable connectors and junction boxes .
Main board component defective. Contact authorized service dealer for main board replacement procedure.
Have you found any wiring faults?
Yes
No
Connect the voltmeter to terminal 2 (signal) and terminal 1 (GND) in the cable reel. Carefully turn the length potentiometer clockwise. Use a small screwdriver to avoid damage.
O turns = - 500mV, 10 turns= - 4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page

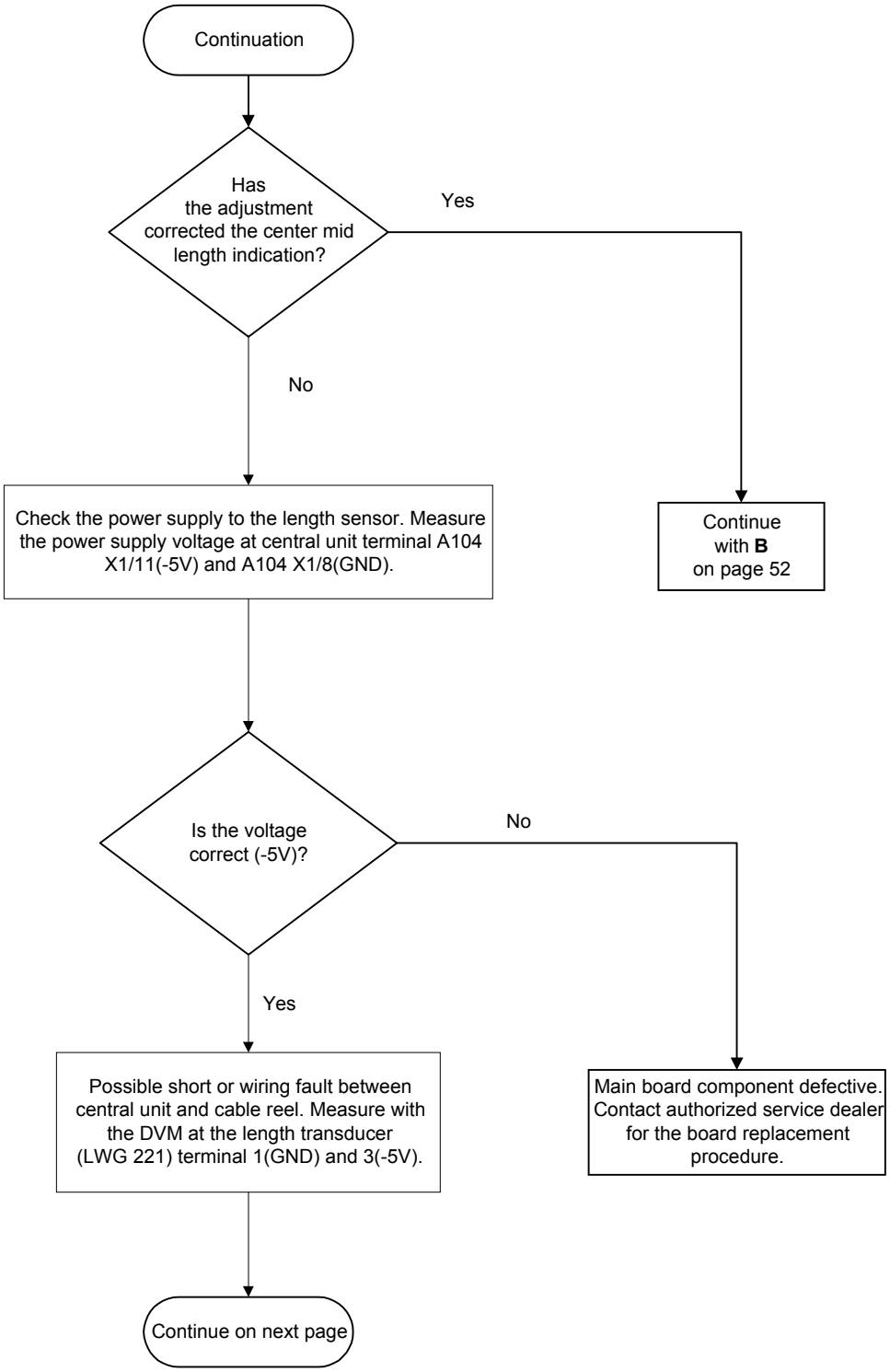
14. Continuation


Continuation
Is the voltage correct? [O turns = - 500mV 10 turns= - 4.5V]
Yes
No
Defective length potentiometer assembly. Replace and adjust length potentiometer. Refer to drawing on page 18.
Refer to page18 and reset length transducer. Possible main board defect. Contact authorized service dealer for further assistance.

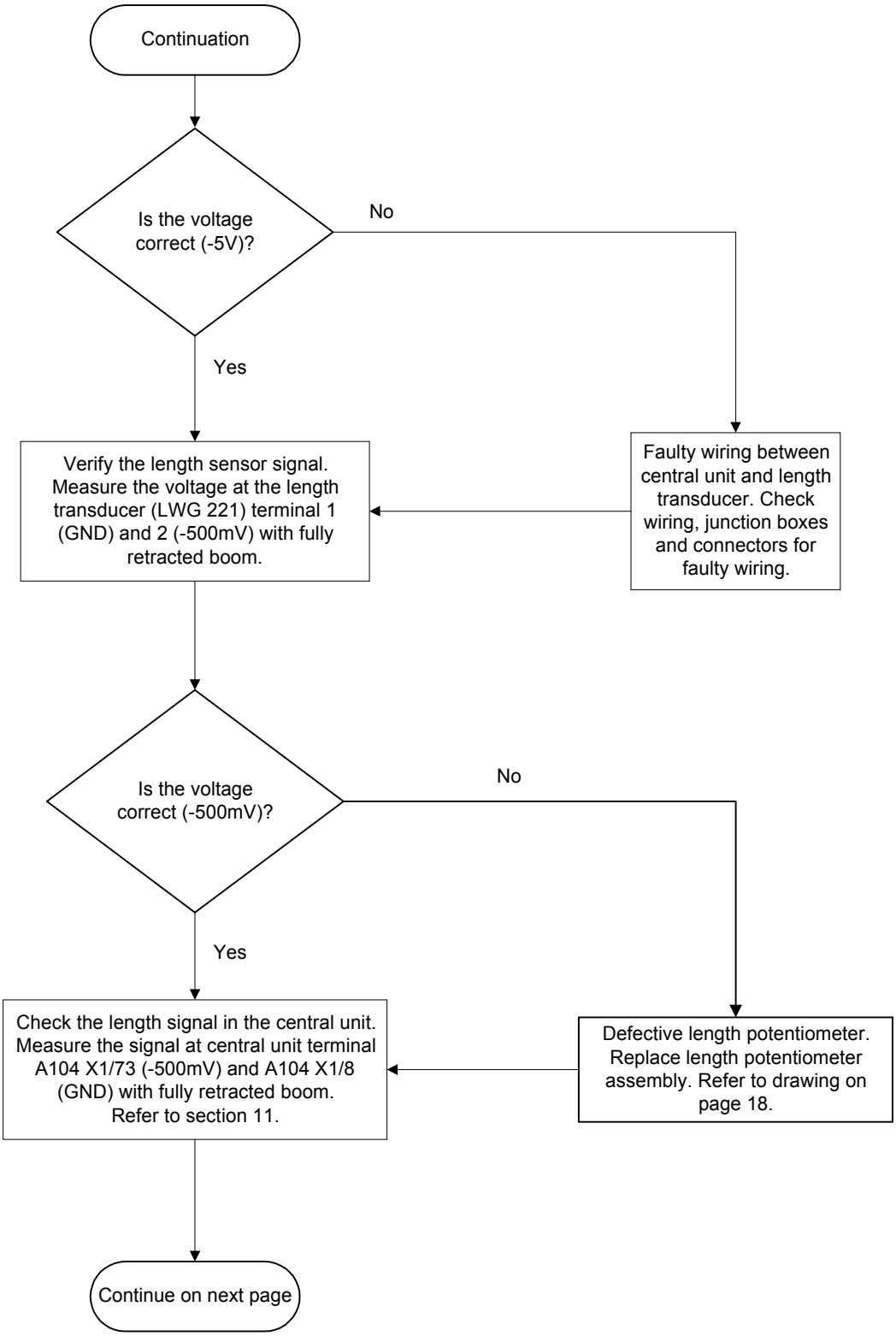
15. Center Mid Length Error


Center mid length error
In manual mode retract all boom sections. Pull the boom stop and retract the inner mid section completely.
Is the center mid length indicated correctly?
Yes
Continue with B on page 52
No
CAUTION: High tension on cable reel drum!
CAUTION: To avoid length potentiometer damage, do not turn the length potentiometer past the stop.
Is the length cable spooled properly on the LWG 221 drum?
No
With all sections completely retracted, un-spool the length cable carefully. Let the drum rewind slowly and spool the cable manually back on the drum. Check the roller guides for correct adjustment. Refer to section 9.1
Yes
Reset the length potentiometer. Refer to page 18 for instructions.
Continue on next page

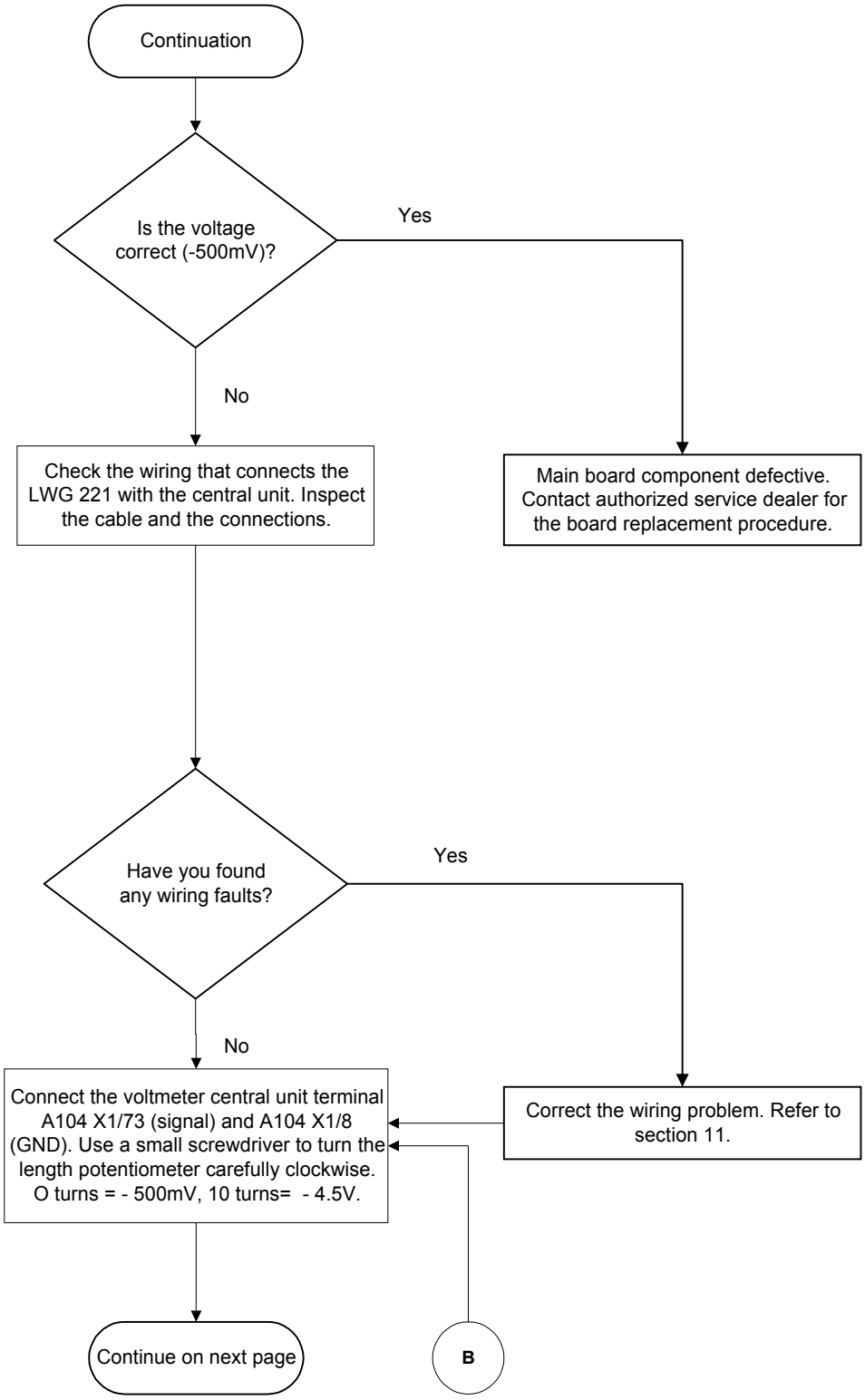
15. Continuation


Continuation
Has the adjustment corrected the center mid length indication?
Yes
No
Check the power supply to the length sensor. Measure the power supply voltage at central unit terminal A104 X1/11(-5V) and A104 X1/8(GND).
Continue with **B** on page 52
Is the voltage correct (-5V)?
No
Yes
Possible short or wiring fault between central unit and cable reel. Measure with the DVM at the length transducer (LWG 221) terminal 1(GND) and 3(-5V).
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Continue on next page

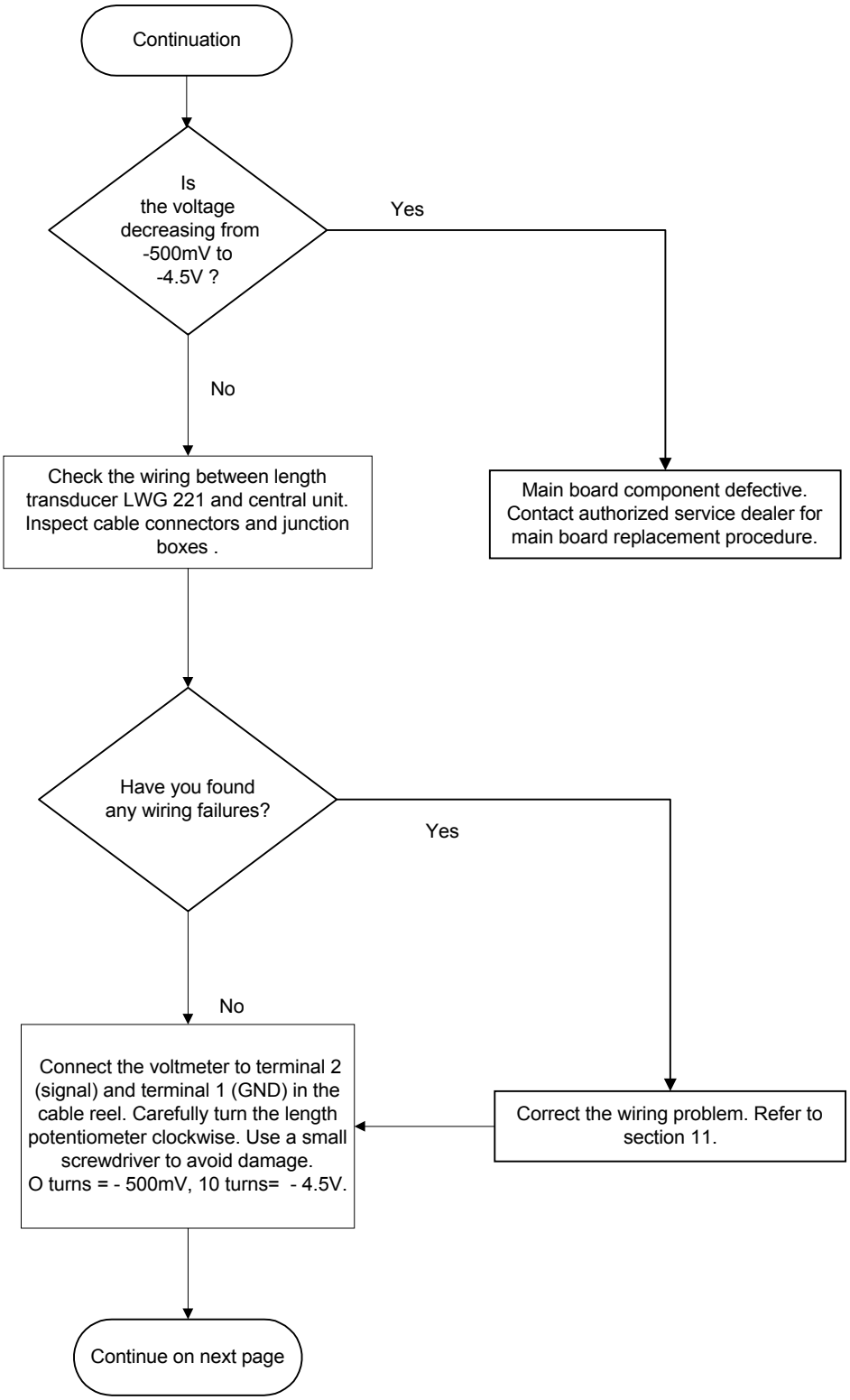
15. Continuation


Continuation
Is the voltage correct (-5V)?
No
Yes
Verify the length sensor signal. Measure the voltage at the length transducer (LWG 221) terminal 1 (GND) and 2 (-500mV) with fully retracted boom.
Faulty wiring between central unit and length transducer. Check wiring, junction boxes and connectors for faulty wiring.
Is the voltage correct (-500mV)?
No
Yes
Check the length signal in the central unit. Measure the signal at central unit terminal A104 X1/73 (-500mV) and A104 X1/8 (GND) with fully retracted boom. Refer to section 11.
Defective length potentiometer. Replace length potentiometer assembly. Refer to drawing on page 18.
Continue on next page

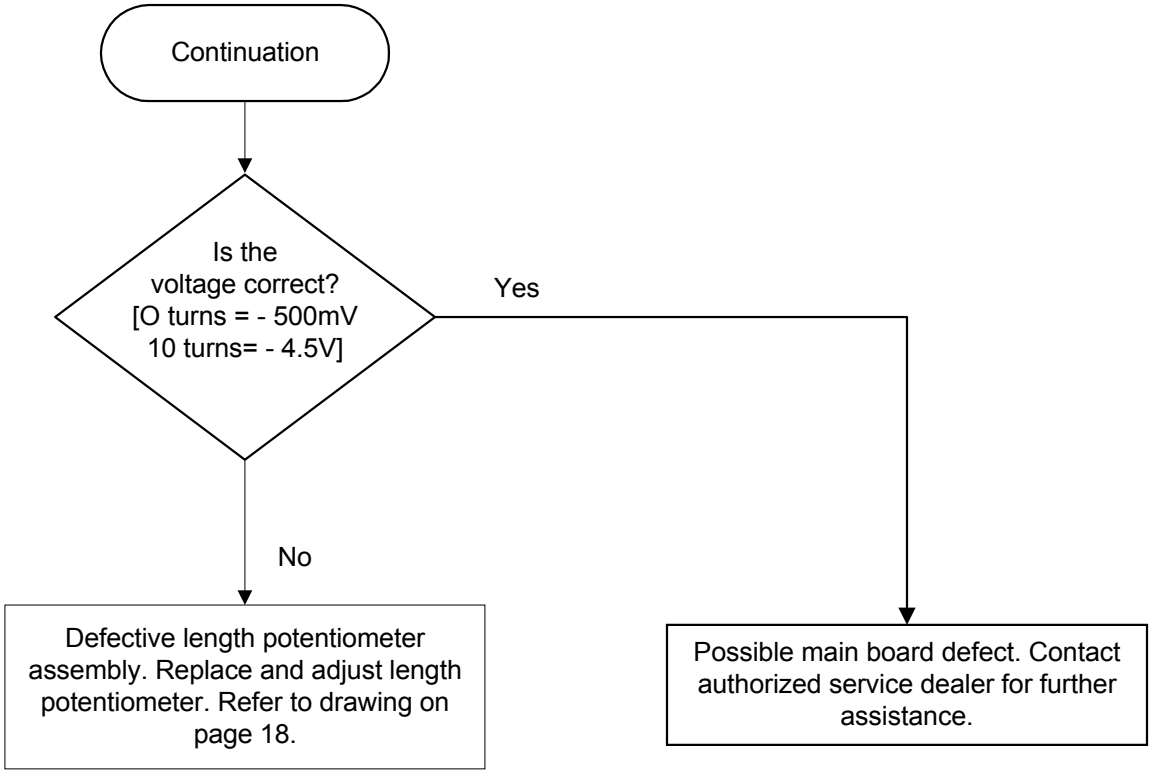
15. Continuation


Continuation
Is the voltage correct (-500mV)?
Yes
No
Check the wiring that connects the LWG 221 with the central unit. Inspect the cable and the connections.
Main board component defective. Contact authorized service dealer for the board replacement procedure.
Have you found any wiring faults?
Yes
No
Connect the voltmeter central unit terminal A104 X1/73 (signal) and A104 X1/8 (GND). Use a small screwdriver to turn the length potentiometer carefully clockwise. O turns = - 500mV, 10 turns= - 4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page
B

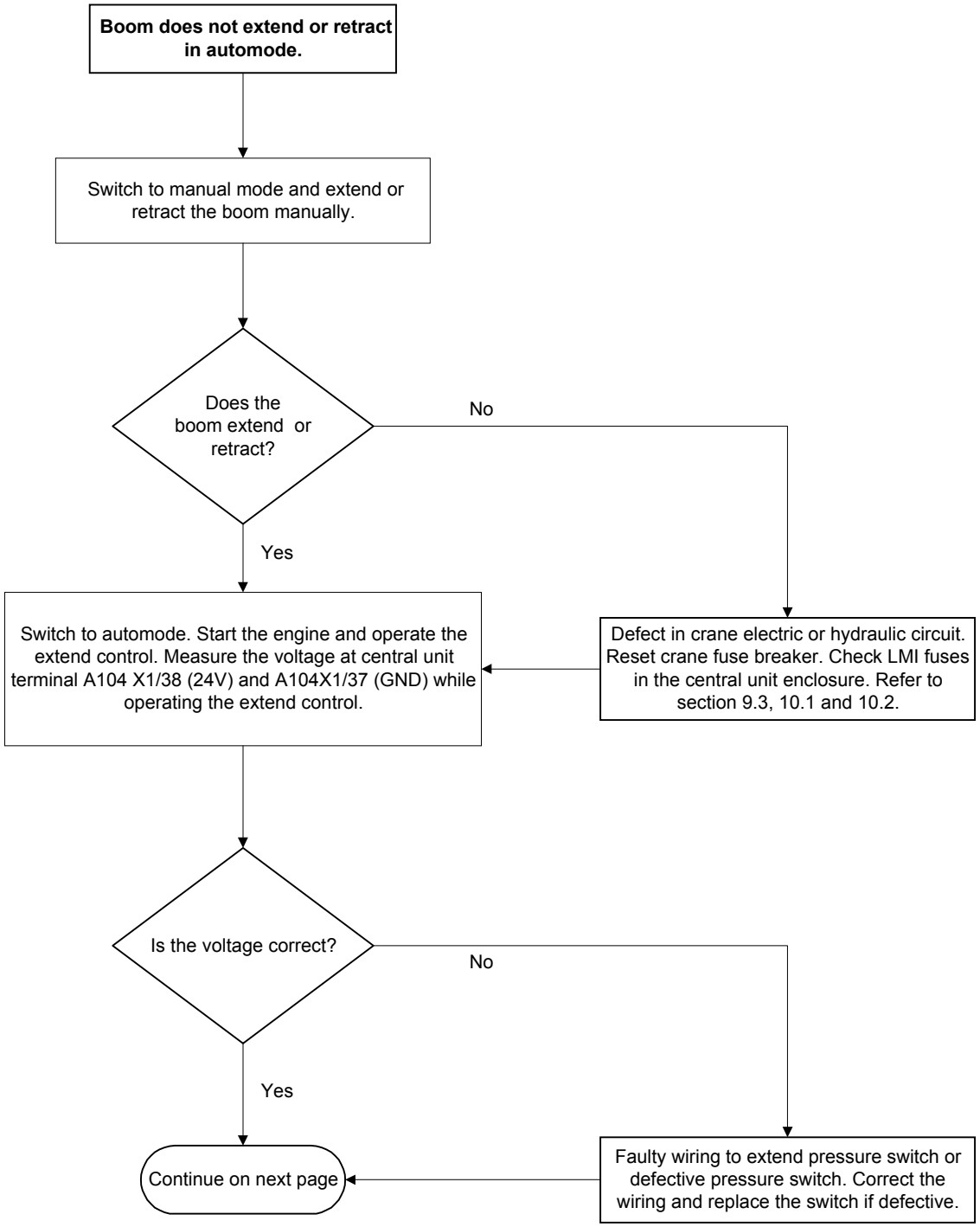
15. Continuation


Continuation
Is the voltage decreasing from -500mV to -4.5V ?
Yes
No
Check the wiring between length transducer LWG 221 and central unit. Inspect cable connectors and junction boxes .
Main board component defective. Contact authorized service dealer for main board replacement procedure.
Have you found any wiring failures?
Yes
No
Connect the voltmeter to terminal 2 (signal) and terminal 1 (GND) in the cable reel. Carefully turn the length potentiometer clockwise. Use a small screwdriver to avoid damage.
O turns = - 500mV, 10 turns= - 4.5V.
Correct the wiring problem. Refer to section 11.
Continue on next page

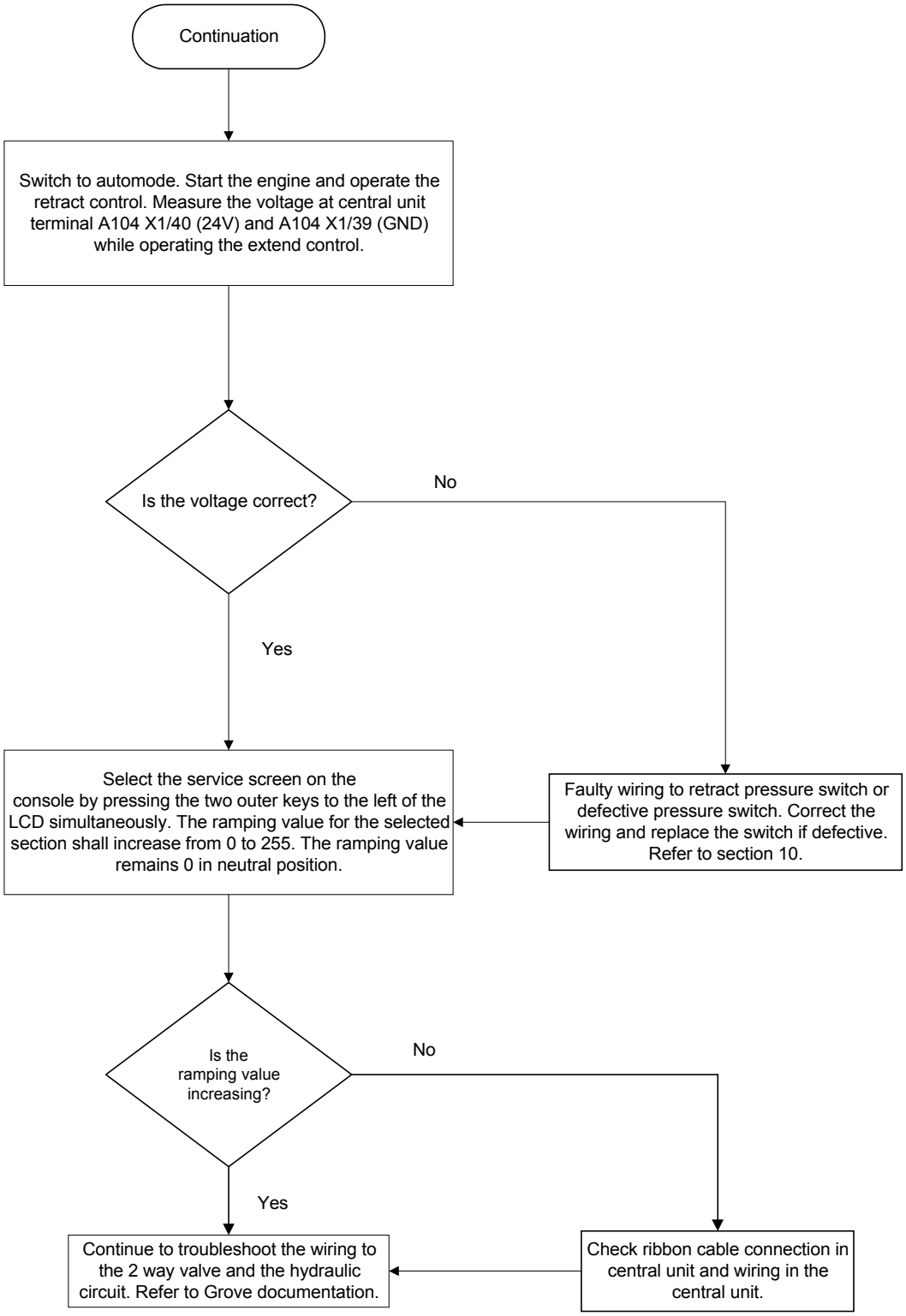
15. Continuation


Continuation
Is the voltage correct? [O turns = - 500mV 10 turns= - 4.5V]
Yes
No
Defective length potentiometer assembly. Replace and adjust length potentiometer. Refer to drawing on page 18.
Possible main board defect. Contact authorized service dealer for further assistance.

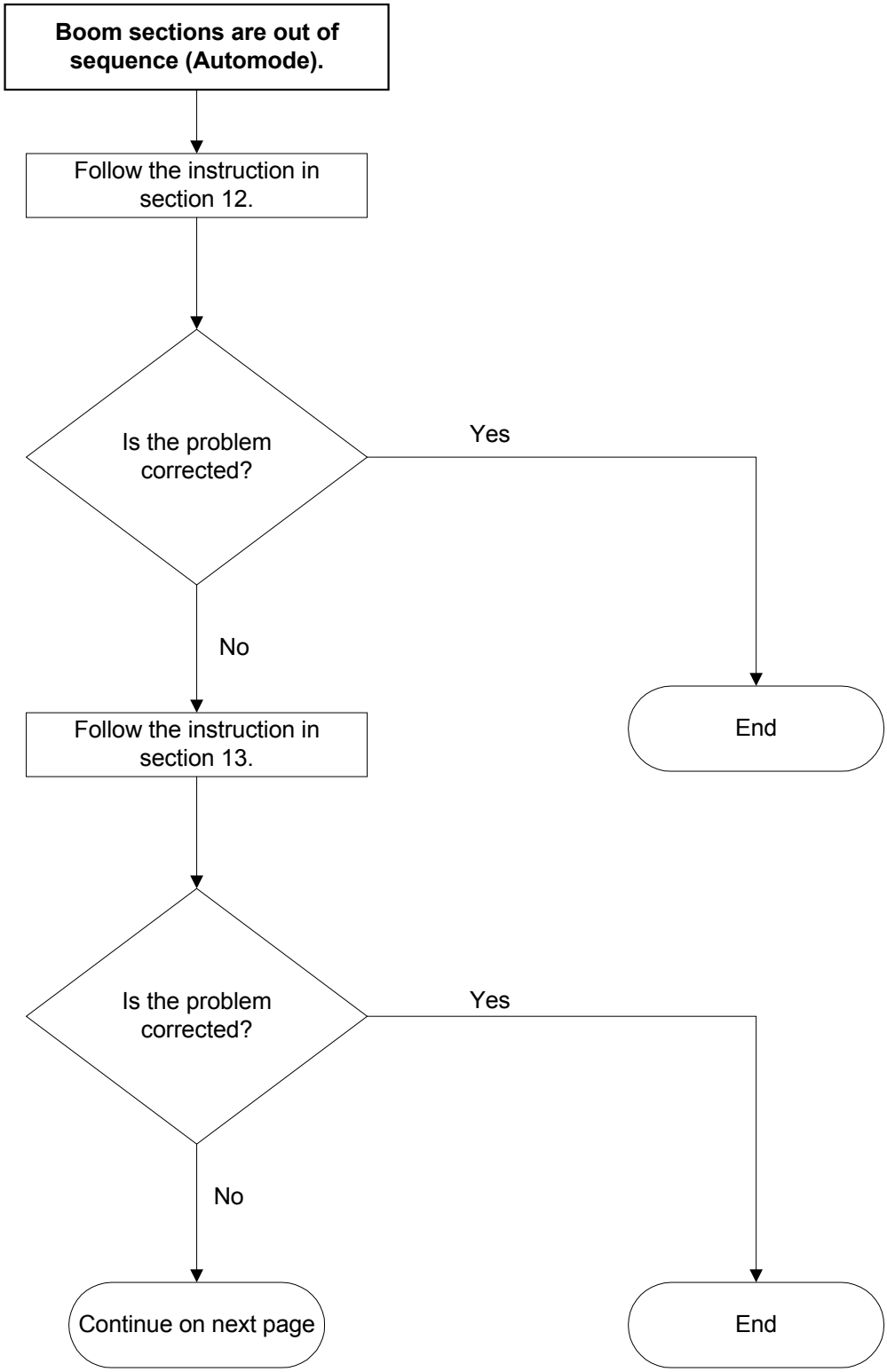
16. No Extend or Retract Function in Automode


Boom does not extend or retract in automode.
Switch to manual mode and extend or retract the boom manually.
Does the boom extend or retract?
No
Yes
Switch to automode. Start the engine and operate the extend control. Measure the voltage at central unit terminal A104 X1/38 (24V) and A104X1/37 (GND) while operating the extend control.
Defect in crane electric or hydraulic circuit. Reset crane fuse breaker. Check LMI fuses in the central unit enclosure. Refer to section 9.3, 10.1 and 10.2.
Is the voltage correct?
No
Yes
Continue on next page
Faulty wiring to extend pressure switch or defective pressure switch. Correct the wiring and replace the switch if defective.

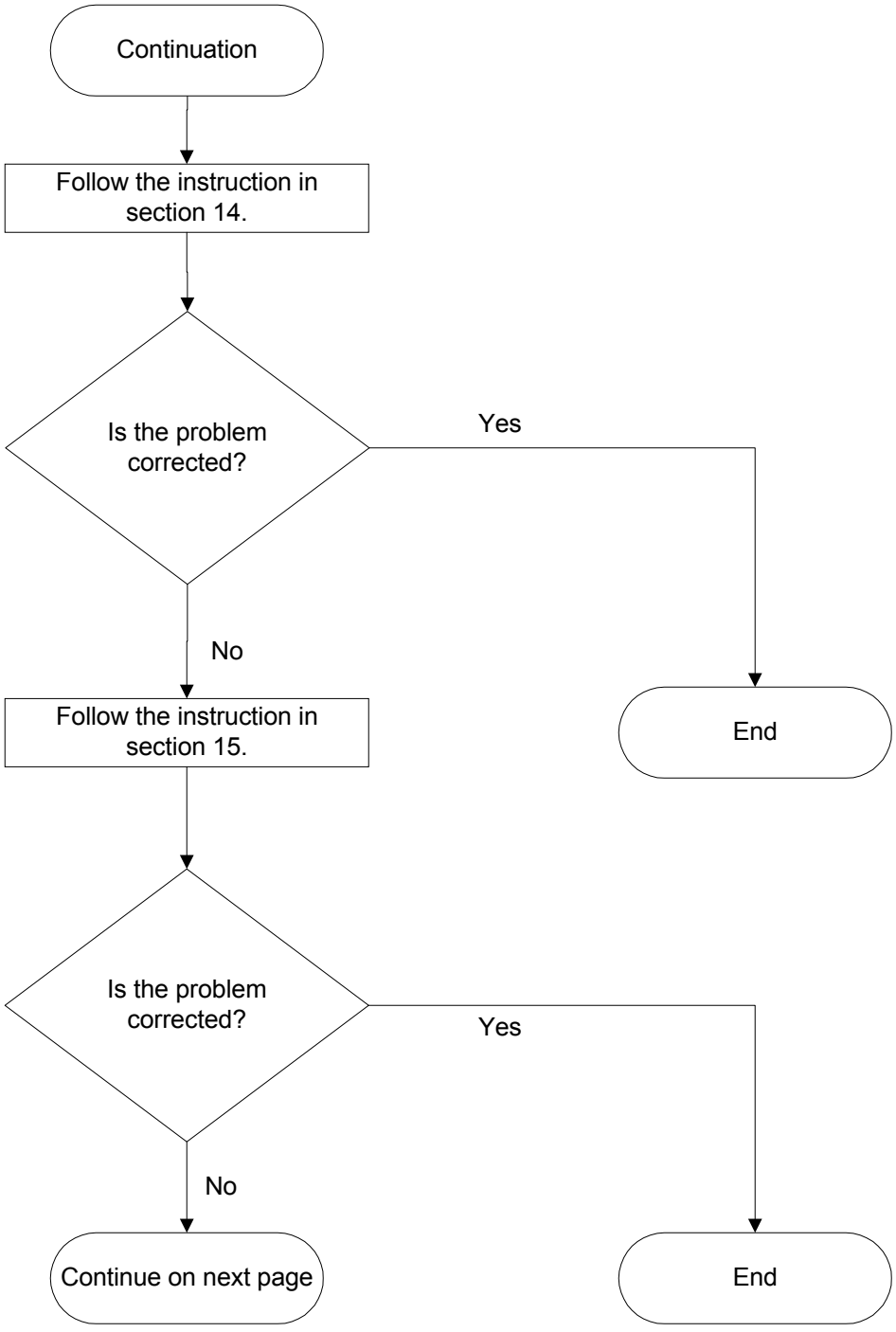
16. Continuation


Continuation
Switch to automode. Start the engine and operate the retract control. Measure the voltage at central unit terminal A104 X1/40 (24V) and A104 X1/39 (GND) while operating the extend control.
Is the voltage correct?
No
Yes
Faulty wiring to retract pressure switch or defective pressure switch. Correct the wiring and replace the switch if defective. Refer to section 10.
Select the service screen on the console by pressing the two outer keys to the left of the LCD simultaneously. The ramping value for the selected section shall increase from 0 to 255. The ramping value remains 0 in neutral position.
Is the ramping value increasing?
No
Yes
Check ribbon cable connection in central unit and wiring in the central unit.
Continue to troubleshoot the wiring to the 2 way valve and the hydraulic circuit. Refer to Grove documentation.

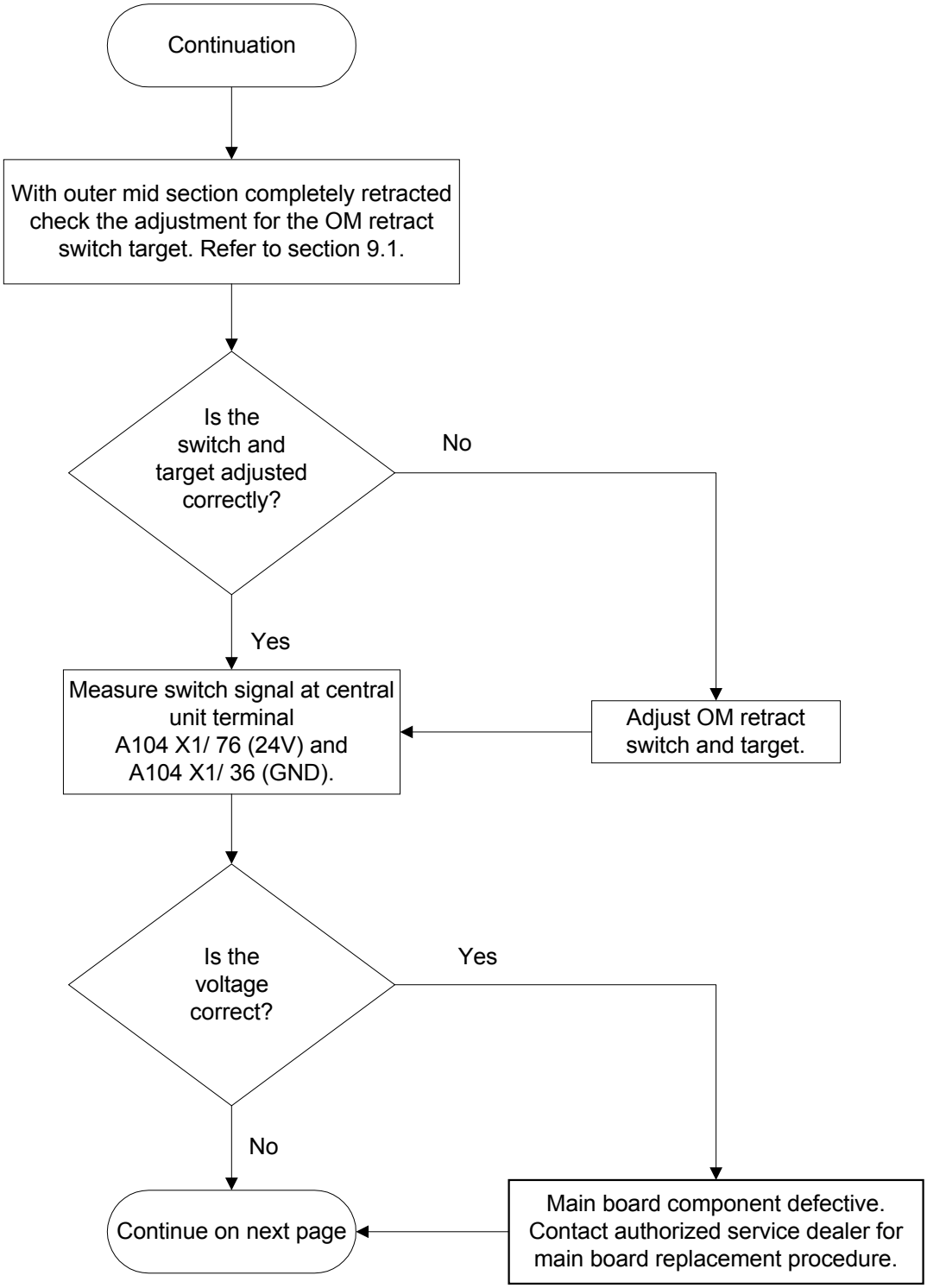
17. Out of Sequence Warning



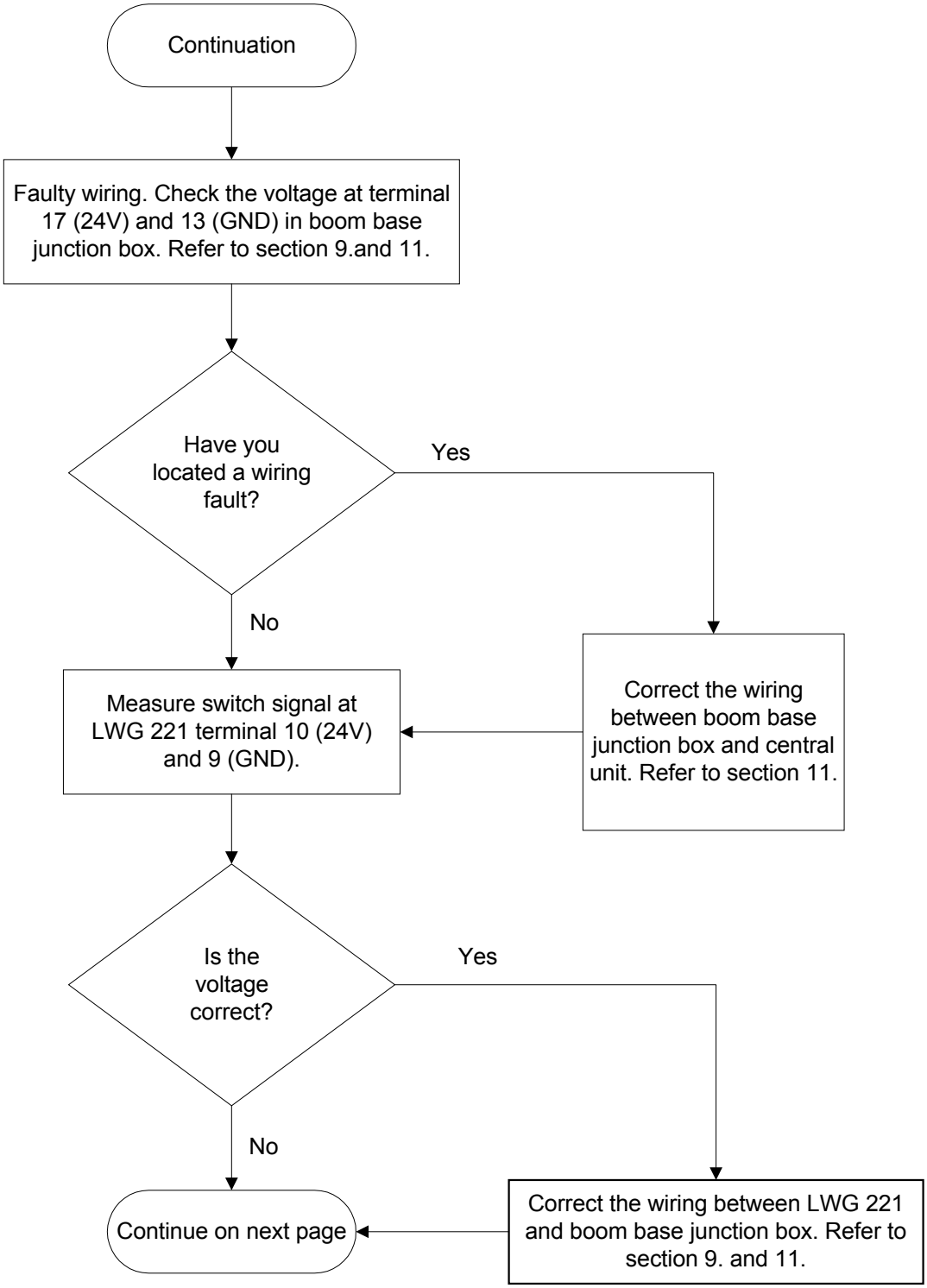
17. Continuation



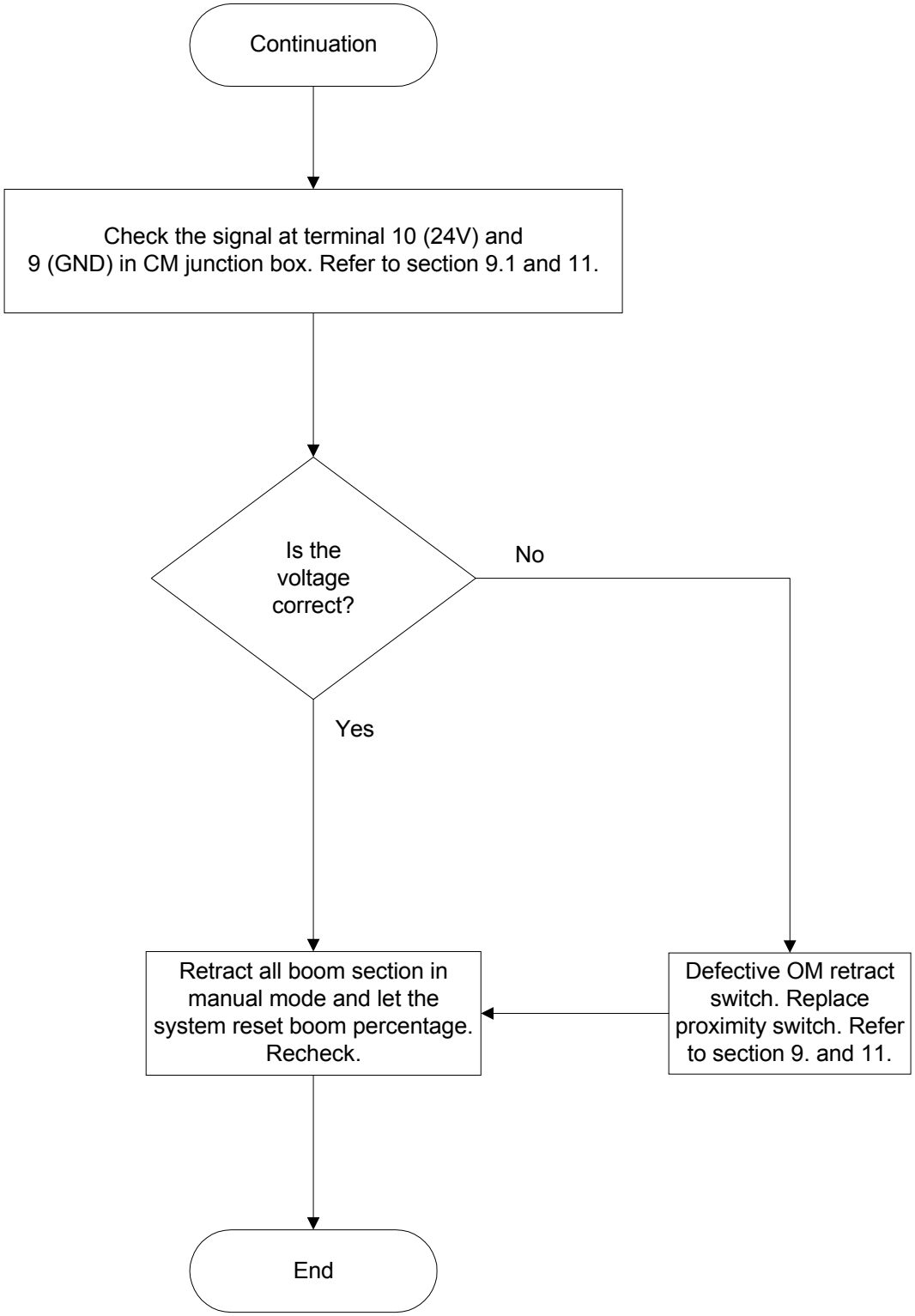
17. Continuation


Continuation
With outer mid section completely retracted check the adjustment for the OM retract switch target. Refer to section 9.1.
Is the switch and target adjusted correctly?
No
Yes
Measure switch signal at central unit terminal A104 X1/ 76 (24V) and A104 X1/ 36 (GND).
Adjust OM retract switch and target.
Is the voltage correct?
Yes
No
Continue on next page
Main board component defective. Contact authorized service dealer for main board replacement procedure.

17. Continuation


Continuation
Faulty wiring. Check the voltage at terminal 17 (24V) and 13 (GND) in boom base junction box. Refer to section 9.and 11.
Have you located a wiring fault?
Yes
No
Correct the wiring between boom base junction box and central unit. Refer to section 11.
Measure switch signal at LWG 221 terminal 10 (24V) and 9 (GND).
Is the voltage correct?
Yes
No
Correct the wiring between LWG 221 and boom base junction box. Refer to section 9. and 11.
Continue on next page

17. Continuation


Continuation
Check the signal at terminal 10 (24V) and 9 (GND) in CM junction box. Refer to section 9.1 and 11.
Is the voltage correct?
No
Yes
Retract all boom section in manual mode and let the system reset boom percentage. Recheck.
Defective OM retract switch. Replace proximity switch. Refer to section 9. and 11.
End

18.1 Additional Error Codes - Operational

Error code	Description	Solution
E18	Front Stabilizer overloaded	Achieve a safe working area immediately.
E83	The outer mid section and fly section are not fully retracted while the center mid section or the inner mid section retracts or extends. No cut off with E83, but *flashing pre-warning light* in console and *reduced capacity chart* (rigging mode).	Select manual mode. Manually retract the outer mid and fly section until fully retracted. Return to auto mode. Check fly section cable adjustment. The fly section shall not be extended when center mid section is fully retracted.
Flashing % indication	Out of telescope sequence (rigging mode selected). The red warning light “Out of sequence” in the console panel lights up.	Select manual mode. Rectify the solution by manually operating each telescope until % indication stops flashing and the red warning light “Out of sequence” in the console panel is dim. Return to auto mode.

18.2 Additional Error Codes - System

Error code	Description	Solution
E 47	Processor can not locate analog output circuit for center mid section	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only).
E 60	*DATA- EPROM* is not plugged into the correct socket or location is not programmed correctly in the *EPROM*.	Refer to the trouble shooting manual and identify the correct location for the data eprom.
E70	No or wrong return signal from digital input extension module to processor.	Digital input circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.
E80 / E98	No or wrong return signal from analog output extension module (for inner mid section) to processor.	Analog output circuit defective. Replace module. Ribbon cable (DS 350G only) defective or bad connection. Replace cable. Decoder circuit defective. Replace decoder module(DS 350G only). Defective input circuit on main board. Call authorized service personnel.